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Archæology in India

THE report on the work of the Archæological Survey of India, recently drawn up by Sir Leonard Woolley at the request of the Central Government, should prove extremely helpful to the advancement of knowledge of India's past history. It is short and easily read, and deserves to be widely understood, for it suggests ways in which, at an extra cost so small as to be negligible compared with present normal cost, the country could benefit from archæological work to a far greater extent than it has done hitherto.

It points out that "Archæology could and should play a far more important part than it does in the life of the Indian people. In a country where the historical sense has been but little developed, where historical knowledge is very limited and is then confined for the most part to that political history in which the bias of party feeling tends rather to the perpetuation of old animosities than to the consciousness of national unity, the study of the growth of civilisation is the most salutory of all studies. Especially for an Indian at the present time is it important that he should learn how the India which he knows has come into being, understand what is in the light of what has been, and in the clashes of race and creed should stress not the accidents of strife but the power of the Indian spirit to assimilate what was good, even in an enemy culture, without sacrificing its own individuality. Here archæology can help and the Archæological Survey as the official organ of archæology has a duty to perform." This is the point of view from which the whole report has been prepared.

To achieve such ends far more attention needs to be paid to the interpretation of archæological remains than is the case at present, a coherent plan of campaign for

filling the largest and most serious of the many gaps in Indian archæological history should have precedence over continuance of work on sites already comparatively well known, and publication of results needs to be so reorganised as to bring the Department into closer touch with the general public. These and the provision of adequate training are the fundamental recommendations made, but they all involve considerable modification of present practice, and the modifications needed are carefully considered.

The report pleads especially that fair opportunities be given to members of the staff, and points out that this will necessitate specialisation within the Department, for its work "comprises the conservation of ancient monuments, which requires historical knowledge, architectural appreciation and good taste; excavation and exploration, which demand specialised knowledge of a high order such as can be obtained only by years of experience and very careful tuition, to say nothing of such technical equipment as drawing, surveying, photography, etc.; museum work, which is again a life-work in itself. Every member of the staff is expected to be proficient in the work of conservation and excavation, may at any time be put in charge of a museum, and is in addition saddled with a mass of clerical and office work for which he has no special qualifications. In short, each member is expected to be a super-man, and that by the light of nature, for he receives little or no tuition in any of those branches. It should be obvious that with so many diverse calls upon him no man can adequately answer to any of them." "There is in the present staff admirable material, and vacancies in the staff can be filled from the ranks of Indian scholars and individuals of genuine promise; but they must be given a fair opportunity. I have made the acquaintance of nearly all the officers in the service and am convinced that they would be the first to welcome a definition of function and an education that would equip them for the work which they are most anxious to do, just as I believe they would be the first to appreciate the point of the criticisms I have been compelled to make, criticisms which in many cases echo their expressed opinions." "Training and tuition are essential. Unwillingly but inevitably I have been forced to the conclusion that this cannot be got in and from the Department as at present constituted. In the matter of the conservation of standing monuments the Department, following carefully the precedents laid down in the past, has done and is doing admirable work to which I can give unstinted praise; only where the preservation of excavated buildings is concerned, for which the precedents are more doubtful, have they indulged in an exaggerated policy which is wasteful financially and its results scientifically deplorable. In the matter of excavation I have on most sites which I have visited found that the methods employed were bad, trained observation conspicuous by its absence, and the results in consequence incomplete and untrustworthy. In the matter of museum direction the report of Messrs. Markham and Hargreaves is sufficient condemnation; the work is amateurish throughout and is seldom informed by any idea of the purposes which a museum should serve. If the present efforts of the Department can be so characterised it is manifest that the staff, before it can train others, must itself be trained; I therefore recommend the employment of a temporary Adviser on Archæology who could deal with all the points at issue." In Sir Leonard's opinion such an adviser could in five years give the Department all the special training it needs to enable it properly to fulfil its obligations to the country and to train future entrants itself. Such a super-man will on his own showing not be easy to find, and he is careful to indicate how he should be selected (p. 34). The grounds for his admiration of the

conservation of standing monuments by the Department and of his criticisms of their excavation work, conservation of excavated buildings, and management of museums are set forth on pp. 21–32.

On pp. 4–7 the most promising sites for immediate excavation are discussed, and it is pointed out in conclusion that before sites can be selected with really adequate knowledge "there is an enormous amount of preliminary work to be done. Assisted by Circle Officers the archæological staff should from now on be busied in preparing an archæological survey of the whole country. Sites of every kind should be visited, listed, mapped, and a carefully made selection of potsherds, coins, etc., collected from each should be filed for identification when the results of excavation make identification possible. I have ventured to recommend sites for excavation on the strength of the study of gazetteers, archæological reports and such personal investigation as I have been able to make in the course of three months; but the Director-General ought to have at his disposal a detailed survey which would enable him to draw up a programme for future work calculated most surely and most economically to answer to the varying demands of advancing knowledge. Virtually nothing has yet been done in this direction. The task is one requiring organisation and will not yield immediate results, for until the collections of pottery, etc., can be assigned to their place in the type-sequence which only excavation can establish, the sites must remain undated; but the material will be there and the filed information will be of permanent value; but it is one which cannot be taken in hand too soon." The establishment of a pottery sequence—or it may be several such sequences for different parts of the country—is considered to be probably the most immediate need, for without it the dating of sites and of the various strata they reveal will in most cases remain impossible.

Another line that needs to be taken up at once is the investigation of Stone Age remains. "India is one of the richest countries in the world for remains of the earliest phases of man's existence. .... The efforts of keen amateurs such as Foote only emphasised the importance of the problems to be solved; recently a foreign mission has done some pioneer work in the North-West; but it is not too much to say that this rich field has been entirely overlooked by the Archæological Survey of India and remains unknown to science. The neglect of it by the Archæological Survey is due to the fact that the study of Stone Age antiquities is highly specialised and lies quite outside the scope of the ordinary archæologist; it requires a particular type of training, geological knowledge, etc., and no member of the Survey's staff is at all capable of dealing with it. For this very necessary branch of work to be undertaken specialists must be engaged, and so vast is the field that such should form a permanent element of the staff."

If anything like adequate attention is to be paid to the almost unlimited number of sites that seem likely to repay excavation the Archæological Survey, even if much more liberally financed than at present, will need all the outside help it can get. It should co-operate with universities and museums, and do all in its power to attract expeditions from outside the country. But in doing so it must insist that nothing is excavated except directly under fully qualified expert supervision, and that the country's interests are adequately safeguarded in the matter of the removal of antiquities. In regard to the latter, evidence is given of the need for tightening up existing practice in certain respects and for a much greater generosity in others, and amendments to the Ancient Monuments Preservation Act are suggested both in regard to these matters and to private ownership of and trading in antiquities (pp. 9–16). The

most interesting and important objects should only be preserved on the site when, as at Sarnath near Benares, this is easily accessible from some important centre of population, never when it is inaccessible as at Nagarjunakonda. And it should be the aim of the Department to see that the various types of sculpture that have developed at various times in various parts of the country are well represented in museums, both in India and abroad, provided they will be safely preserved and properly utilised for public education. Only first class specimens can worthily represent India's achievements, and in their absence from foreign museums the country will not get a reasonable chance of receiving the appreciation it deserves.

After discussing in detail the departmental changes recommended, and their financial implications, the report concludes "At present the country expends twelve and a half lakhs and gets, in my opinion, very poor value for its money; there is indeed no justification for so great an expenditure unless there is to be a very great improvement in the work done by the Department, and there is no chance of such improvement unless the Department be radically reformed. But given reforms on the lines I have suggested, and this small extra expenditure which they involve, India will in a short space of time be in possession of a first class archæological service which will amply repay its cost. The material for such a service is ready to hand and it only requires to be trained and organised to be of the utmost value both to international science and to the cause of popular education in this country. If on the other hand it be decided that a country so poor as India cannot afford the extra half lakh of rupees which the scheme of reform demands, then I can only say that it is not justified in spending, as at present, some twelve lakhs for which it gets so inadequate a return. It would be better to set aside roughly six lakhs for continuing the upkeep of the ancient monuments already conserved and to close down the Department of Antiquities until the finances of the country were in a more prosperous state or until criticism in India and abroad made the resuscitation of the Department unavoidable."

The report contains valuable suggestions some of which—such as wider co-operation with other institutions—had already been initiated by the present Director-General before it was written. It is to be hoped that its strong wording will not be allowed to interfere with the careful consideration that it obviously deserves, and that the Central Government will not fail to provide the funds necessary to initiate all such developments as this consideration may show to be desirable. India is so large a country that it is impossible to stop or even adequately check the destruction now going on of scattered megalithic antiquities, sculptures, etc. (most of them still unknown to investigators) by road menders, builders, amateur excavators, etc. And if the other alternative is adopted and all but the conservation side of the Department closed down for a time, much of the priceless evidence now available will inevitably have disappeared before it can be investigated and recorded.

The Indian Journal of Entomology

WE have much pleasure in welcoming the entry of a new Indian Scientific Periodical—*The Indian Journal of Entomology*—into the arena of Indian Scientific Journalism. It is intended to be the organ of the Entomological Society of India, which was inaugurated in January 1938 at Calcutta, at a joint meeting of Indian and British Entomologists on the occasion of the Jubilee Session of the Indian Science Congress. Although entomological work has been in progress in India for over fifty years, it is a rather strange circumstance that there has

been till now no Indian periodical entirely devoted to entomological science. Papers on general entomology were being published either in the *Records of the Indian Museum*, the *Journal of the Bombay Natural History Society* or the *Journal of the Royal Asiatic Society of Bengal*, or in foreign periodicals, especially in the United Kingdom. Results of work done on applied entomology, on the other hand, found entry generally into the publications of the Agricultural, Forest or Medical Departments. As only finished work could be accepted in these journals, there has been till now no scope for the record of occasional observations or stray notes by amateur entomologists or beginners in entomology. *The Indian Journal of Entomology* has been designed to meet a long-felt want of entomological workers in India. Whatever the line of work they are engaged in, whether they be systematists or morphologists, whether they be amateur collectors or applied workers on agricultural, medical, veterinary or forest problems, the Journal will be equally open to them for purposes of publication. The Entomological Society of India has established branches at important centres in different parts of India, wherein local members could meet periodically, read and discuss and exhibit any interesting finds.

We may congratulate the editorial staff of the Journal on the excellent get-up of its first number (Parts 1 and 2), which was received sometime ago. It includes, besides the Introduction, the congratulatory messages received from foreign entomologists, an interesting "Retrospect of Entomology in India", and several articles of high scientific value. There are, besides, various interesting notes in connection with the exhibits and communications made at the Branch Meetings of the Entomological Society of India. Reviews of recent research work and of books and monographs offer items of great value to workers—especially such as are beyond the reach of good scientific libraries. "News and Announcements" provide a very welcome fare for the entomological readers, full of human interest. We wish the new Journal a long and successful career.

Cosmic Ray Symposium at the University of Chicago

By P. S. Gill

(University of Chicago, U.S.A.)

DURING the last week of June, there was held at the University of Chicago a notable Symposium on Cosmic Rays under the Chairmanship of Professor Arthur H. Compton. Among the leading workers on cosmic rays who took part in the discussions were Professors V. F. Hess, Fordham University; Carl D. Anderson, California Institute of Technology; W. Heisenberg, Leipzig; W. Bethe, Heidelberg; J. Clay, Amsterdam; M. S. Vallarta, Massachusetts Institute of Technology; and Bruno Rossi, formerly of Padua.

Since the early balloon experiments of Hess in Austria in 1912, by which he established the existence of the rays, the study of cosmic rays has contributed much to the fundamentals of physics. Carl D. Anderson discovered positive electrons among his cosmic rays and found evidence for the presence also of the new sub-atomic particle, the meson. Cosmic rays provide a very effective tool for studying the components of atoms and how their nuclei are put together. The discussions were followed with seriousness and interest.

Among the major findings reported may be mentioned conclusive evidence for the existence of mesons, new data with regard to their remarkable penetration, evidence that

they can be formed as rays in the atmosphere by the impact of energetic particles with atoms, and apparently also of their spontaneous disintegration by a kind of radioactive process. Neutrons are much more abundant in cosmic rays than had previously been suspected. It now seems probable that the incoming cosmic rays consist partly of protons, and that these come from our own galaxy.

Studies on the intensity of cosmic rays on the Pacific Ocean reported by A. H. Compton and P. S. Gill reveal that the atmospheric temperature coefficient of cosmic ray intensity is a function of latitude, having a lower value at lower latitudes, a result predicted both by Blackett from his theory of disintegration of mesons and by an alternative method by Vallarta and Godart. M. S. Vallarta and O. Godart of the Massachusetts Institute of Technology discussed their theory of world-wide periodic variations of the intensity of cosmic radiation, based on the interaction of sun's magnetic field with the magnetic field of the earth. Cosmic ray intensity measurements carried out in unmanned balloons at high altitudes by Millikan and Neher at Omaha and W. P. Jesse at Chicago indicate that the intensity is less in summer than in winter.

Investigations carried out by C. D. Anderson and Seth Neddermeyer using a vertical cloud chamber in a strong magnetic field show that the energy loss of shower particles in heavy materials is in accordance with the Bethe-Heitler theory. The experiments reveal further the existence of particles which are more penetrating than electrons but whose specific ionization is not as much as is to be expected if they were protons. P. Auger's experiments at Paris show that electrons and photons often occur in widely spread showers sometimes as far as a thousand feet apart, all appearing to originate from the same parent ray high in the atmosphere. The energy of the original ray which gives rise to such a shower of photons and electrons must sometimes be greater than a million billion electron volts. Dr. S. Korff of the Bartol Research Foundation described a series of his high altitude balloon flights in which associated with these photons and electrons he found the existence of a large number of neutrons. The rate of increase of neutrons is even more rapid with altitude than is the increase in the main body of cosmic rays. It appears possible that the neutrons result from the disintegration of the nuclei of nitrogen atoms when struck by the primary cosmic rays that come from outside the atmosphere. T. H. Johnson also adduces arguments to show that the primaries of the hard component are presumably protons or another type of heavy nuclear particle. A discussion of the mechanism of the production of mesons, however, by W. Heisenberg of Leipzig, indicated that very probably protons should be more important in affecting atomic nuclei than should any of the lighter types of particles. Studies of energy distribution of bursts made by P. S. Gill and M. Schein of Chicago pointed out that at sea level under 12 cm. of lead, the large bursts are produced by mesons because of the similarity of the energy spectrum of a burst-producing radiation to that of the energy spectrum of cosmic rays at great depths as measured by V. C. Wilson of Chicago. They also calculated the cross-section of 2×10^{-30} cm.^{2} per nuclear particle (proton or neutron). The latter value is comparable to that estimated by Heisenberg in his theory of nuclear explosions.

V. C. Wilson of the University of Chicago reported measurements of cosmic rays made in various underground locations, which revealed the existence of the penetrating meson at least to a depth of 400 feet. On the basis of his own new experiments at great depths, J. Clay of Amsterdam suggested that below 400 feet the predominant form of radiation may be protons. Whether this view is correct remains to be answered by further experiments.

The Symposium has not only brought together the leading workers in the field of cosmic rays but the discussions have given many new ideas for further investigation. The generosity and the hospitality of the Chairman, Professor A. H. Compton, added greatly to the success of the Symposium.

Magnetostriction

By D. S. SubbaRamaiya

(Department of Physics, Central College, University of Mysore)

THE term *"Magnetostriction"* is applied to denote that class of phenomena in which changes in the state of magnetisation of a body are accompanied by changes in its physical dimensions or form and conversely, mechanical deformations of the body are accompanied by changes in its state of magnetisation. A number of such effects all closely related have been reported. Although these phenomena have been known for a very long time, they were, until recently, only of academic interest. During the last ten years, however, increasing attention has been devoted to the subject and considerable progress has been made. The subject has now acquired a theoretical importance on account of its intimate connection with the theory of magnetism and a practical significance through applications such as the magnetostriction oscillator.

Mechanical Deformations due to Changes in Magnetisation

It was first discovered by Joule in 1842 that a ferromagnetic rod, when placed in a magnetic field with its length parallel to the lines of force, alters in length when the strength of the field is changed. This phenomenon is known as *"The Joule Effect"*. The actual change is very small and its accurate measurement is possible only by means of sensitive instruments like extensometers, interferometers, or ultramicrometers.

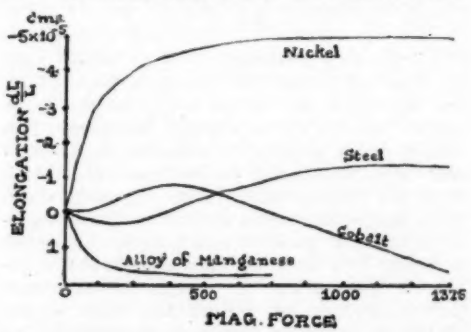

FIG. 1

The curves in Fig. 1 illustrate the influence of magnetic fields in the case of iron, cobalt, nickel and an alloy of manganese. Iron shows an increase in length for weak fields and decrease for strong fields. Nickel exhibits a shortening for all field strengths and the Heusler alloy behaves in quite the opposite way. Cobalt behaves in a manner just the opposite of iron. It has also been found that there is hysteresis attending the Joule Effect and it is closely related to the familiar magnetisation hysteresis.

In addition to the change of length, it has been found that the area of cross-section changes when the rod is magnetised longitudinally (the so-called *'transverse Joule Effect'*). There is also a change in the Young's modulus consequent on magnetisation. Wiedemann discovered that due to the interaction of longitudinal and circular magnetic fields a twisting of the specimen ensues (*'Wiedemann Effect'*). The coefficient of rigidity is affected considerably by change in magnetisation. Barett showed that the volume of a magnetic material changes if its magnetisation is altered (*Barett Effect*).

Changes in Magnetisation due to Mechanical Deformations

The effect of mechanical deformations on the magnetisation discovered by Villari is of great interest. Villari found that if an iron rod is stretched its intensity of magnetisation increases in a weak magnetic field but decreases in a strong field. This is known as the *Villari Reversal Effect* and the point V

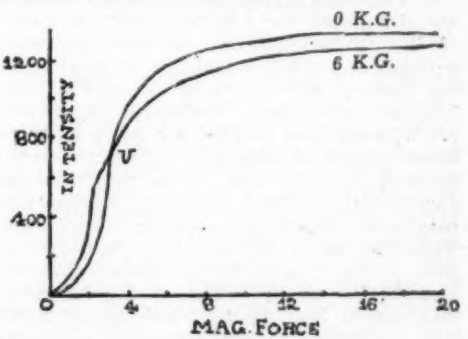

FIG. 2

where stretching or compressing does not affect the intensity of magnetisation is known as the Villari Reversal Point. The *Villari Effect* is the reciprocal of the Joule Effect. A change in magnetic induction due to normal stress has also been shown to exist and is known as the *"transverse Villari Effect"* as against the transverse Joule effect.

Wiedemann has found that if a circularly magnetised rod is twisted it develops longitudinal magnetisation (*Second Wiedemann Effect*) and Wertheim, that a longitudinally magnetised rod when twisted develops circular magnetisation (*Wertheim Effect*). Nagaoka and Honda have shown that a change in the volume of the specimen is accompanied by a change in its state of magnetisation (*Nagaoka-Honda Effect*). This is the opposite of the *Barett Effect*.

In all these experiments great care must be taken to maintain the external conditions such as temperature and pressure constant. The exact nature of the change in any specimen depends upon its previous history (thermal treatment, magnetisation, stresses and the like) and may be considerably altered by processes such as annealing. The actual magnitudes of these changes being very small, special devices have to be employed to measure them. A detailed account of these various effects and their measurements is given by S. R. Williams.[1]

Single Crystals of Magnetic Materials

It is obvious that work with single crystals would be more useful in disclosing the nature of the magnetostriction phenomenon than with samples of polycrystalline material about the history and structure of which little is generally known. Webster,[2] Honda and Mashiyama[3] have studied the Joule effect in single crystals of iron using different orientations of the specimen. They find that the Joule effect exhibits anisotropy, its sign and magnitude depending upon the orientation. The effects are much larger in single crystals than in the polycrystalline metal. Takaki[4] has studied the variation of the magnetostriction of iron crystals with temperature. The behaviour of the crystal is markedly different along different crystallographic axes. Similar experiments have been made by Nishiyama[5] and Mashiyama[6] on crystals of cobalt and nickel.

Alloys of Magnetic Materials

Studies of magnetostriction in alloys of magnetic materials have been carried out by Schulze,[7] Mashiyama[8] and others. It is interesting to observe the gradual change exhibited by iron-nickel alloys with varying percentages of nickel. The curves in Fig. 3

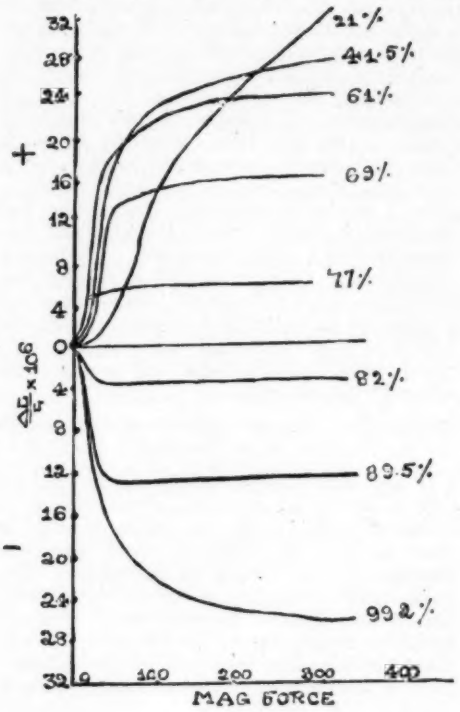

FIG. 3

illustrate this strikingly. With small percentages of nickel the curve is seen to be entirely positive, while with nearly pure nickel the curve is practically inverted. The change from positive to negative is continuous with increasing percentages of nickel, with the result that an alloy in which there is no magnetostriction whatever the magnetising force, is possible and does in fact occur at about 80% nickel. This alloy is the well-known *'permalloy'* in which the magnetic permeability is very high for small values of the magnetising force. In the case of the silicon-steel alloys there appears to be some evidence that at a percentage of silicon slightly above that used for stalloy, the

curves from being similar to that in iron tend suddenly to invert as in the case of nickel-iron.

Para- and Dia-Magnetic Materials

In ferromagnetic substances, magnetostriction is easily observed in ordinary magnetic fields. In para- and dia-magnetic substances, however, no magnetostriction is observed at such fields. Kapitza[9] made a study of non-ferromagnetic substances using very intense fields. The measurements in strong fields lasted only for a fraction of a second and hence had the advantage that while the scale of the phenomenon was much magnified, all disturbances due to accidental variations in temperature were eliminated. He also made an extensometer, capable of measuring to 10^{-7} cm. which was as sensitive in the brief time of experiment as those used for long duration measurements. Using single crystals of bismuth, Kapitza found that magnetostriction was very closely connected with crystal orientation both as regards its sign and magnitude. Variation of the effect due to changes in field strength, changes in temperature, and addition of impurities were studied. Some effects were also observed in antimony, graphite, gallium and other substances.

The phenomenon of magnetostriction is of fundamental importance in the theory of magnetism. It has been the usual practice in building up theories of ferromagnetism to ignore effects such as these and then by rather arbitrary additions to give them place within it. Of late, however, several attempts have been made to include the magnetostrictive data in the foundations of a theory of ferromagnetism. McKeenhan,[10] Fowler and Kapitza[11] have considered the question. Kapitza has also discussed the results he has obtained with diamagnetic materials in relation to the modern theory of diamagnetism. However, it may be said that only a beginning has been made in this direction. The study of magnetostriction promises to throw light on the subject of interatomic forces in solids and the architectural design of the elementary magnet, the atom. It is of great importance therefore to obtain accurate data in ferromagnetic as well as non-ferromagnetic substances under specified conditions. Study of other phenomena which are related to magnetostriction such as the change in resistance in a magnetic field, change in thermo e.m.f. due to a magnetic field, e.m.f.'s due to magnetisation and the Barkhausen Effect on the same specimens of material may provide the theoretical investigator with useful information.

The Magnetostriction Oscillator

The principle of magnetostriction has found several practical applications in the laboratory and elsewhere. What appears to be of rather great significance is the development of valve oscillating circuits whose frequency can be controlled by the utilisation of the magnetostriction effect, and conversely of circuits which can maintain intense vibrations based on the same principle. The first "magnetostriction oscillator" was set up by Pierce[12] ten years ago, in which the frequency was controlled magnetostrictively. The circuit used (Fig. 4) is essentially a Hartley

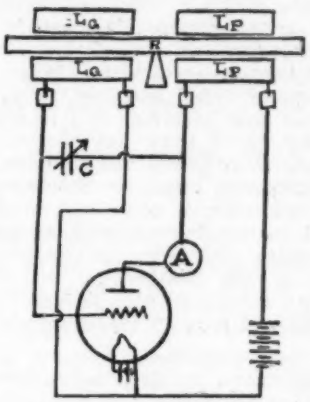

Fig. 4.

arrangement with two separate grid and anode coils, which are tuned by a variable capacity C. The spatial coupling between the coils is loose, and the magnestrictive rod is placed axially in the centre of the two coils, supported at its midpoint. When the oscillating circuit is tuned to near the natural frequency of the rod, an additional coupling due to magnetostrictive action arises thus: a small change of current through L_g changes the magnetisation of the rod, which thereby suffers a change in length. This deformation of the rod transmitted to the grid coil side, causes an equivalent change in magnetisation and induces an e.m.f. in the coil L_g. This induced e.m.f. on the grid

produces an amplified change in the plate circuit and thus in L_g. This coupling is maximum at the natural frequency of the rod and the oscillations are maintained at the same frequency. More recently Pierce[13] has developed an oscillator which functions only under the control of the vibrating rod, and is inactive otherwise.

Magnetostriction Oscillator used as a Frequency Standard

Extensive investigations have been made by Pierce and his collaborators on the development of magnetostriction controlled frequency standards. The material suitable for use as a vibrator must have a large magnetostrictive effect and must maintain constancy of frequency in spite of changes in temperature, magnetisation, condenser settings and vacuum tube characteristics. For these purposes iron and irons with various carbon contents are found to be relatively useless, as they have too small magnetostriction coefficients. Pure nickel, and alloys of nickel and iron, or alloys of cobalt and iron, nichrome and monel metal are found to be very powerful vibrators. The temperature effects can be overcome by using composite vibrators, consisting of a tube of one material and a core of different material, the two having opposite coefficients of expansion. In order to prevent undue lengths at low frequencies, nickel tubes filled with a material such as lead in which the velocity of sound is small are used.

The magnetostriction oscillator is found to be effective in the range between the very low audible frequencies and nearly two million cycles per second in the supersonic range. Harmonics can be developed up to frequencies of several million cycles per second. Above 300,000 cycles per second, however, the vibrations are found to be too feeble. In the range between 300,000 cycles and 25,000 cycles per second, the magnetostriction oscillators and the piezo-electric oscillators have a common range of usefulness. Below 25,000 cycles per second however, *i.e.*, in the upper audible range, on account of the difficulty of obtaining sufficiently large crystal vibrators, the magnetostriction oscillator is very useful. The constancy of frequency of the magnetostriction oscillator compares favourably with that obtained by the piezo-electric crystal oscillators.

Magnetostrictive standards of frequency have been set up by Pierce and his coworkers. They have been used to control electric circuits in the apparatus for supersonic research such as superhet sonic amplifier, standard signal generator and microvoltmeter and in the calibration of wavemeter and frequency meters. The velocity of sound in various metals and alloys have been measured and their elastic constants (with their temperature coefficients) have been obtained. By using the vibrator as a source of sound, the transmission of sound over reflecting surfaces has been investigated.

The relevant literature on these developments is largely to be found in the *Journal of the Acoustical Society of America*, 1938, Vol. 9.

Oscillators of very High Amplitude

Newton Gaines[14] was the first to study the effects at very high amplitudes of the oscillator. The object was to increase the power input of the resonant magnetostrictive nickel tubes to the limit set by the mechanical properties of nickel and then to discover and investigate properties of the intense sound produced by longitudinal vibration. The apparatus is essentially a high power oscillator with the nickel tube mounted axially in the field of the coils.[15]

With a vibrator of this type it is found that the amplitudes of vibration could be easily measured with ocular micrometers. The amplitudes are so high that nickel tubes are quickly ruptured. The sound produced is of sufficient intensity to cause pain to the unprotected ear. Metal plates, when held at one end to touch the rod are found to be eroded. When the sound beam is directed on to a beaker or a flask, the vessel is broken. A piece of cork driven into the tube is found to be burnt. The vibrations produce a considerable emulsifying effect, stable emulsions of transformer oil, benzene and mercury in water being easily obtained. Dispersions of carbon and other substances could be obtained. When introduced into a vessel of water from below, fountains as high as 9 cm. are produced. All these disruptive effects are due to cavitations produced by the intense sound waves. Chambers[16] reports that there is emission of light from the cavity in the case of some liquids (fourteen liquids, among the

thirty-six examined show this effect). Using a magnetostriction oscillator, Porter and Leona Young[17] have shown that a molecular rearrangement can be brought about by powerful ultrasonic waves. Salisbury and Porter[18] have constructed a very powerful magnetostriction oscillator which operates with a power input which can be varied continuously between 0 and 2000 watts in order to use it as a source of intense ultrasonic waves in connection with their experimental work on the mechanisms of some organic reactions. The oscillator was also satisfactorily adopted by Gaines and Chambers, to form a continuous laboratory process for the sterilization of market milk. One of the most important applications of magnetostriction is found in the magnetostriction echo depth recorder[19] which is used for taking soundings at sea and has now reached the stage of being produced commercially.

Summary

The phenomena which have been grouped together under the heading "*Magnetostriction*" are briefly described. Experimental results on the magnetostriction of ferro-, para- and dia-magnetic substances, single crystals and alloys are considered and the theoretical importance of the phenomenon pointed out. The development by Pierce of the magnetostriction oscillator and its importance as a frequency standard has been indicated. Use of oscillators of very high amplitudes in the laboratory for the investigation of physico-chemical problems and their important industrial applications have been mentioned. The article is in the nature of a review of the recent progress made in the subject of magnetostriction that has become one of great importance.

The author of this article feels grateful to his Professor, Sir C. V. Raman, F.R.S., N.L., who gave him facilities to set up a magnetostriction oscillator in his laboratory at the Indian Institute of Science, Bangalore.

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Garo Hill Cotton

In the course of testing samples of cotton at the Technological Laboratory received from different parts of India, a sample of Garo Hill cotton from Assam was subjected to fibre and spinning tests. These tests revealed that this cotton possesses a number of exceptional features which are described below as they may be of interest to those working on cotton. The sample in question was supplied by the Deputy Commissioner, Garo Hills, Assam, to whom the writer is also indebted for the relevant agricultural details.

This cotton is grown in the northern half of the Garo Hill District. The soil is of the sandy loam and black clay type and the seed is sown in April/May. The picking is done in January and February nearly eight to nine months after sowing, while from May to September the crop receives a very heavy rainfall, which, in the current year, amounted to nearly 112 inches. There was, in addition, a rainfall of 7½" in April and over 4" in October; the total rainfall in the current year being nearly 124 inches.

The seed of this cotton is somewhat larger than that of *desi*-type and is densely covered with lint. The ginning percentage was found to be 49·8, the lint from 100 seeds weighing 8·05 grams, while the seeds themselves weighed 8·1 grams. The high ginning percentage is especially noteworthy.

The results of the fibre tests made on this cotton are given below in Table I.

Table I

Fibre Particulars

1. Fibre-Length Distribution (Balls Sorted):

Mean group length in eighths of an inch	Percentage
	Garo Hill Cotton
2	2·3
3	5·1
4	15·2
5	35·8
6	30·1
7	8·9
8	2·6

2.	Fibre-length (inch)	
	(*a*) By Balls Sorter ..	0·65
	(*b*) By Baer Sorter ..	0·66
3.	Fibre-length irregularity (%)	14·9
4.	Fibre-weight per inch (Millionth of an oz.) ..	0·391
5.	Fibre-strength (oz.) ..	0·221
6.	Intrinsic strength ..	0·57
7.	Ribbon width (thousandth of an inch) ..	0·98
8.	Swollen diameter (thousandth of an inch) ..	1·49
9.	Maturity (%)	77–14–9
10.	Standard hair-weight (Millionth of an oz.) ..	0·380
11.	Convolutions per inch ..	69
12.	Wax Content (%) ..	0·212

It will be noticed that the cotton is a short stapled type, having a staple length of only about 5/8" but the most remarkable features about it are its high fibre-weight per inch, ribbon width and swollen diameter. Hitherto, nearly 5,000 samples of cotton have been tested at the laboratory, and in all probability the values of these three properties of this cotton are highest on record here; while owing to its high fibre-weight per inch, the intrinsic strength (the fibre-strength per unit fibre-weight per inch) is probably the lowest on record. Another remarkable feature about this cotton is its extremely low wax content, which again is the lowest on record in this Laboratory. This low wax content gives it a peculiar harsh feel, which is very characteristic of the cotton. Furthermore, for its length, this cotton possesses rather high fibre-length irregularity percentage and rather low percentage of mature fibres.

The cotton was also subjected to a spinning test in the Laboratory, and it was found that, even with a moderately high twist, the 6's warp yarns spun from it did not possess the requisite strength. This is due partly to its low staple length and partly to its high fibre-weight per inch. The cotton, however, though not so suitable for spinning purposes, would be excellent, owing to its harsh feel, for mixing with wool; also, provided it could be given a softening treatment, it would form a suitable material for the manufacture of hospital lint after removing the small amount of wax associated with it.

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August 26, 1939.

Biochemical Synthesis of Colouring Matter by an Indian Strain of Penicillium Mold

The chemistry of colouring matters synthesised in higher plants has received considerable attention lately and the constitution of some have already been established. Colouring matters are also produced by some of the lower plants like molds and actinomycetes, the colour being usually located within the mycelium or cells and in a few cases it diffuses out into the culture medium. The colouring matters of the lower plants have not been studied systematically at all except in isolated cases by a few workers like Raistrick,[1] Friedheim,[2] Blochwitz,[3] and Griegarieva-Manoilova and Poradieeva,[4] etc. Amongst the Penicillium group of molds, although the fact that they have the capacity of producing pigments is known, systematic attempts at elucidating the constitution of the pigments or the mode of their synthesis are extremely rare, the only work in this field being that of Friedheim who has experimented with *Penicillium phœnicum*.[3] This is probably due to lack of suitable micro-organisms which can produce pigments in experimentally workable amounts. Therefore the isolation from an indigenous source of a species of Penicillium which readily yielded scarlet coloured culture solutions has afforded an opportunity of studying the interesting problem of colour production. The present note is a preliminary report of the work so far done.

Whilst carrying out a survey of the microflora habitating on fruits of Northern India a mold was encountered on some of the samples of over-ripe William pears obtained from Kulu valley in the Punjab, which appeared to belong

to the Penicillium group of fungii and was an efficient producer of brilliant red to scarlet coloured pigment. It may be interesting to note that Galloway[5] has found the acid soils of the hilly districts of India to be abundantly infested with Penicillium molds. In order to obtain the mold in pure culture the infected fruit was scraped and the scrapings shaken in physiological saline and the latter plated out in suitable decimal dilutions on oatmeal-maltose-agar or potato-maltose-agar medium. The discreet colonies of the chromogenic mold were picked out and replated after having been successively grown a few times on a medium consisting of: maltose 0·5%, aspargine 0·1% and potassium phosphate 0·01%. This medium is obviously unfit for the vigorous growth of yeasts and is therefore suitable for freeing the mold from yeasts and even fungii imperfectii which occur abundantly on the fruits.

Culturally the mold strongly resembled the Penicillia. On liquid media it has a greyish white occasionally yellowish growth. In forty eight hours the colour of the mycelium becomes green on account of the appearance of spores and the medium starts turning red. After 2-3 weeks the medium is deep red and the mycelium consists of dense closely woven hyphæ, the surface is deep green and the reverse velvity and red-brown in colour. On malt agar the vegetative growth is restricted, dense but irregular, spores abundant, conidial areas deep green, the medium rapidly turns deep red. The cultures on agar were sent to the centraalbureau voor Schimmelcultures *Baarn* Holland and have been stated to be identical with *Penicillium crateriforme* isolated by Gilman and Abbot[6] in 1927 from the soils of Louisiana, Iowa and Utah States in America. It may be pointed out that climatically there is a resemblance between the above mentioned American States and the Indian district from where the present strain was isolated. The somewhat surprising fact should here be mentioned that Oxford and Raistrick[7] in a study of biochemistry of '*Penicillium crateriforme* Gilm and Abb' in which they have used the well-known Czapek-Dox medium have failed to notice any reddening of the culture solution even after twelve weeks; only the mycelium is stated by them to acquire in the later stages a faint pink or occasionally a brick-red colour.

The physiological needs of this mold are quite simple, a small amount of carbon source and a trace of nitrogen being all that is necessary. Such simple sources of carbon as ethyl alcohol, ethylene glycol, glycerine, isopropyl alcohol, acetone and lactic acid are assimilated although growth is more prolific with more complex carbohydrates. For the production of colour organic nitrogen compounds of intermediary complexity like amino-acids, peptides and peptones are more suitable nutrients than inorganic nitrogen on the one hand and albumins and proteins on the other. Amongst the sugars pentoses like arabinose and xylose are the most suitable substrates for colour production. Laevulose is converted slightly more readily than dextrose; galactose, mannose, sucrose and maltose and also to a lesser extent lactose readily yield the colouring matter, whilst trehalose, raffinose and to a small extent also dulcite and mannite give the red pigment. Dextrin gives little or no colour. In order to get comparable results in such experiments the coloured medii were collected at the end of a definite number of days, filtered, made to known volume and the amount of pigment produced compared in the Lovibond tintometer. Triplicate lots of medii were taken in each case in order to avoid experimental error which is otherwise very large. From the point of view of elucidation of mechanism of the pigment synthesis, it is naturally important to find out the simplest carbon compounds which can be utilised by the mold-enzymes in building up the complicated pattern of the pigment molecule and here experiments with pregrown mycelium have brought out the interesting fact that a number of simple carbon compounds can be converted into the colouring matter. The mold was first grown on a sucrose medium, the mycelium collected, washed well, cut into small

round pieces and placed on the surface of the new media under examination; precautions being taken during the whole operation to avoid extraneous infection. Blank tubes with distilled water were used as controls and their Lovibond tintometer values subtracted from those obtained with the actual medii. In this way it has been found that the following substances readily give the pigment: methyl and ethyl alcohols, glycerine, amyl alcohol, ethcylene glycol, tartaric, dihydroxytartaric, citric and mucic acids, and acetone. It is quite likely that synthesis of the pigment from the carbohydrates proceeds *via* any of these compounds.

For the large-scale production of the pigment sucrose has been selected as the substrate on grounds of convenience and economy. The medium contained in flasks consists of sucrose 0·5%, Bacto peptone 0·10% and potassium phosphate 0·01%, final pH after autoclaving or steam sterilisation at 100° C. was about 6. After inoculation with spores of the organism from an agar culture, the flasks were incubated at 30° C. Red colour begins to appear in about three days from the top and the colour slowly extends and the whole liquid turns red in one or two weeks, maximum reaching in about 2–3 weeks. The culture liquid is decanted off from the mycelium, filtered, mixed with 10–15% its volume of hydrochloric acid, left aside for half an hour and then extracted with about 30–35% its volume of amyl alcohol used in two portions. The amyl alcohol extracts are washed once with water, dried over sodium sulphate and the solvent distilled off *in vacuo*. The residual pigment is stirred up with a little ether or petroleum ether which dissolves out a brownish impurity, and the pigment is collected. This gives a deep red to chocolate coloured powder in a yield of about 0·100 gm. per litter of the culture solution. The crude pigment melts indefinitely between 180–200° C., can be adsorbed on suitable grades of alumina, and is precipitated from aqueous solutions with lead acetate. With ferric chloride no detectable deepening of colour occurs but strong acids or alkalies turn the bright red colour of an aqueous solution to an orange colour. It is oxidised to colourless form by boiling with hydrogen peroxide. It is insoluble in usual organic solvents, but dissolves readily in amyl alcohol from which it is not easily washed out with water. An aqueous solution appears deep red in ordinary light and greenish-brown under the mercury vapour lamp. The biochemistry of the synthesis of the pigment is being studied and its constitution will be examined when workable amounts have been prepared.

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J. N. Ray.

University Chemical Laboratories,
Lahore,
August 25, 1939.

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Diet and Detoxication

During the present year, an investigation has been undertaken in this laboratory with a view to answer the question, "Can the rate of elimination of conjugated glucuronic acid be used to test the metabolic function of the liver?" In this connection, a large number of estimations were conducted, by an improved and comparatively recent technique,* on conjugated

* Salt's modification[1] of Tollen's naphthoresorcinol test has been used throughout these experiments. The final blue-violet colour of the ethereal extract was examined in a Pulfrich photometer, using filter, No. S. 53 with a wave length of 530 μ, and the result expressed in terms of the colour absorption (extinction co-efficient), which, according to Salt, (1935) is proportional to the quantity of glucuronic acid excreted.

glucuronic acid elimination in 24-hour samples of urine in rabbits and dogs, kept in metabolism cages under standard conditions with respect to diet, etc. Two sets of observations were recorded:—

(*a*) The normal rate of day-to-day glucuronide elimination in rabbits and dogs, maintained under standard conditions for at least 7 days prior to experimentation, is shown in Table I.

TABLE I

	Animal No.	Sex and Wt. (kg.)	† Excretion in 24 hours — Days 1	2	3
Rabbits	7	M. (1·28)	1·3	1·4	1·5
	8	M. (1·33)	1·5	1·5	2·1
	9	M. (1·15)	1·7	1·9	2·3
	16	F. (1·43)	2·1	2·7	3·1
Dogs	1	F. (4·76)	40	43	44
	2	F. (4·90)	34	35	43
	3	F. (6·40)	40	45	49
	4	F. (5·40)	30	34	35

† Average of three determinations in each case.

It will be apparent that in the rabbit, the normal glucuronide excretion level is rather low (range bet. 1 and 4), while in the dog, it is very much higher (range bet. 40 and 50). This difference does not appear to be only a difference in degree (as it cannot be explained on the basis of the differences in the body weight) but is probably indicative of a fundamental difference in the nature of the detoxication mechanism (detoxication through conjugation with glucuronic acid in the liver) in the two animals.

(*b*) To determine whether the degree of response of these two animals, when their livers were exposed to a strain through the administration of a glucuronogenic drug, *e.g.*, chloral hydrate, was identical or not, proportionate doses (calculated on the basis of body weight) of chloral hydrate were administered orally and the effects on conjugated glucuronide elimination noted (Table II).

Here again, a definite difference in reaction between the two animals was noticeable. While both the animals responded to the glucuronogenic drug by showing an appreciable increase in the hepatic glucuronide formation and elimination, the amount of chloral necessary to bring about this change varied in the two animals. The 'effective dose' (dose just

TABLE II

	Animal No.	Sex and Wt. (kg)	* Excretion after chloral Hydrate in 'effective dose' (mgms. per kgm.) — 100	150	200	250	350	450
Rabbits ..	7	M. (1·28)	..	..	..	3·9	2·1	10·8
	8	M. (1·33)	..	..	..	1·8	2·0	12·0
	9	M. (1·15)	..	..	..	1·9	5·0	..
	16	F. (1·43)	..	..	..	2·7	5·1	..
Dogs ..	1	F. (4·76)	60	80	125	..	..	..
	2	F. (4·90)	57	75	110	..	..	..
	3	F. (6·40)	..	..	115	..	..	..
	4	F. (5·40)	..	..	90	..	..	..

* Average of 3 determinations in each case.

sufficient to bring about a measurable increase in glucuronide excretion in 24-hour urine) of chloral in the rabbit varied from 250 mg./kg.–450 mg./kg. Much smaller amounts were needed in the dog, the dose ranging between 100 mg./kg.–200 mg./kg.

From the results obtained, there is little doubt that significant differences exist in the two animals with regard to the rate of hepatic glucuronide formation and elimination. While engaged in a study on cyanide detoxication a few years ago, the senior writer[2] observed a similar difference in the rate of cyanide conversion (into thiocyanate) by the rabbit and the dog. Under ordinary conditions, –CN introduced into the system, is detoxified by being converted into –SCN, the thio-constituents of the body supplying the necessary sulphur. In the rabbit, an almost complete conversion of –CN to –SCN takes place, as evidenced by the recovery of nearly 98 per cent. of administered cyanide as thiocyanate in the urine in about 3 days. In the dog, on the other hand, not more than 24 to 65 per cent. (average 40%) of –CNS equivalent of –CN injected can be recovered in more than a week's time. This difference in the process of cyanide detoxication in the two animals—the rabbit and the dog—lends additional support to the observations already recorded regarding the differential elimination of conjugated glucuronide in the rabbit and the dog.

As the *rabbit* is a typical representative of the herbivorous group of animals and the *dog* of the carnivorous group, it will be of interest to enquire whether the mechanism of detoxication is in any way dependent on the nature and composition of the diet. This speculation is strengthened by the interesting experiments of Miller and Connor,[3] who suggest that glucuronic acid for detoxication purposes can be derived from *food* sources. That the food material has an influence on the efficiency of another detoxication process has been demonstrated by Abderhalden and Wertheimer[4] in the cases of the formation of mercapturic acid and hippuric acids in the rabbit. According to Miller and Connor,[3] the *rabbit* is unable to synthesize glucuronic acid from carbohydrates or amino-acids (or at least performs these syntheses very slowly) but that it can utilise glucuronic acid to a certain extent from its food supply. Guinea pigs apparently behave in the same way as rabbits with regard to glucuronic acid formation (Miller, Siehrs and Brazda).[5] Miller *et al*[6] have shown that the *dog* possesses a store of glucuronic acid, or can synthesize it from carbohydrates and amino-acid metabolites. These evidences indicate that at least as far as glucuronic acid metabolism is concerned, the two animals may behave differently.

A pertinent question that may be raised in this connection, "Is the carnivorous dog better adapted to withstand the introduction into the system of certain poisons than the herbivorous animals?" As far as the conjugation mechanism with glucuronic acid is concerned, the dog is apparently better fitted for struggle against toxins of the type ordinarily detoxified through this mechanism, as it can readily mobilize glucuronic acid from endogenous catabolism which the herbivorous animals are not capable of doing. However, this lack of 'conjugation power' does not necessarily indicate that herbivorous animals like the rabbit and the guinea pig are less capable of neutralising poisons introduced into their body than the dog. Detoxication, which consists essentially in the destruction of a toxic compound or in changing a physiologically active chemical group to one which is less so, is brought about by one or other of the processes of *oxidation*, *reduction* or *conjugation*. It is not improbable that in the herbivorous animals the processes of oxidation and reduction may play a more important part than conjugation whereas in the carnivorous animals like the dog, the reverse may be the case.

The interesting inter-relationship between diet and detoxication is obviously a problem of considerable significance in connection with the biochemical defence mechanisms of the body and in clinical medicine generally. This note is published with the idea of eliciting opinion and of focussing more interest on this subject.

We are grateful to Prof. R. N. Chopra for guidance and help in this investigation.

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Government of India,
All-India Institute of Hygiene and Public Health, Calcutta,
August 21, 1939.

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The Principal Magnetic Susceptibilities of Tellurium Crystal

MCLENAN AND COHEN[1] studied the magnetic properties of single crystals of tellurium and found that the diamagnetic susceptibilities along and normal to the trigonal axis had the same value. A study of the crystal structure of tellurium by Bradley[2] led him to emphasise the uniqueness of the trigonal axis in the crystal.

In this investigation, tellurium crystals were produced by the method of slow cooling. The principal magnetic susceptibilities were determined by the Guoy method.[3]

The principal susceptibilities are found to be — 0·329 parallel to the trigonal axis and — 0·296 perpendicular to the trigonal axis.[4] This leads to a value of 1·11 for the magnetic anisotropy of the crystal. The susceptibility of well-annealed polycrystalline tellurium is found to be — 0·307. This value agrees favourably with those obtained by previous investigators.

When a tellurium crystal is heated, the susceptibility parallel to the trigonal axis decreases, while the other principal susceptibility remains constant. At about 220° C., the two principal values become equal. When the solid melts at 450° C., the volume susceptibility decreases from — 1·7 to — 0·3.

The influence of small admixtures of tin, cadmium, bismuth and lead on the magnetic properties of tellurium single crystal was also investigated. In all the cases, both the principal diamagnetic susceptibilities show a decrease in value. The magnetic anisotropy tends to unity. The diamagnetic susceptibility in the polycrystalline state also shows a decrease. This decrease is found to be larger, the greater the atomic radius of the element introduced. The number of valence electrons in the atom of the added element does not seem to have any influence on the decrease in the mean susceptibility of tellurium.

The atomic susceptibility of polycrystalline tellurium is found to be — 39·2 while according to Kido,[5] the susceptibility of a gram ion of tellurium (Te^{+6}) is — 4·5. The contribution to the total atomic susceptibility of the element by the six valence electrons is — 34·7. This indicates that probably the linkages of the six electrons are not metallic. Tellurium behaves like a nonmetal from the magnetic point of view. This conclusion is substantiated by the large electrical resistance of the element.

Full details will be published elsewhere.

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S. R. GOVINDARAJAN.
Annamalai University,
Annamalainagar P.O.,
September 4, 1939.

[1] *Roy. Soc. Canada, Trans.*, 1929, **23**, 159.

[2] *Phil. Mag.*, 1924, **58**, 477.

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Determination of Dipole Moment in Solution

THE apparent electric moment of ortho-, meta- and para-nitrotoluene is measured in a number of solvents. When polarization at infinite dilution is determined using P_2—f_2 curves, it is found that wherever P_2 changes rapidly with

f_2 the extrapolated value $_{\infty}P_2$ becomes uncertain. Hedestrand's method of mathematical extrapolation to infinite dilution[1] is found to be convenient so long as the variation of ϵ and d with f_2 is linear. When this is not the case graphical extrapolation of $\alpha\epsilon_1$ and βd_1 to $f_2 = 0$ has to be used, and the values are subject to the inaccuracies of graphical methods.

The Sugden relation[2] $P_2 = A \pm B\frac{\epsilon-1}{\epsilon+2}$ is found to hold for all the solutions investigated. This relation can be used to calculate $_{\infty}P_2$ which is the value of P_2 at $\frac{\epsilon_1-1}{\epsilon_1+2}$, ϵ_1 being the dielectric constant of the solvent. Since the Sugden relation is linear $_{\infty}P_2$ can be calculated by mathematical computation. $_{\infty}P_2$ so calculated is found to agree, wherever possible, with the values obtained from graphical extrapolation and Hedestrand's method. The constants A and B, however, do not carry the significance originally attached to them by Sugden.[2]

In order to correlate the values of $_{\infty}P_2$ and the dielectric constant ϵ of the solvent it was assumed that $_{\infty}P_2 = a\epsilon^b$ where a and b are constants. Hence $\log P_2 = \log a + b \cdot \log \epsilon$. The plot of $\log {}_{\infty}P_2$ against $\log \epsilon$ for solutions of ortho-, meta- and para-nitrotoluene in different solvents shows three parallel straight lines. When the slope of these lines is calculated using the method of least squares the following result is obtained:

Solute	Slope	Correlation coefficient
o-Nitrotoluene	−0·4928	1 − 0·004
m-Nitrotoluene	−0·5256	1 − 0·010
p-Nitrotoluene	−0·5012	1 − 0·004

Thus for the substances investigated $_{\infty}P_2 = a/\sqrt{\epsilon_{solvent}}$. This empirical relation differs from the relation $_{\infty}P_2 \propto 1/\sqrt{\epsilon_{solvent}}$ suggested by Jenkins.[3] When $_{gas}P_2$ is calculated from the empirical relations by extrapolating the graph to $\epsilon = 1$ widely different values are obtained. Thus we have:

Substance	Müller	Sugden	Author	Jenkins
	c.c.	c.c.	c.c.	c.c.
o-Nitrotoluene ..	369	454	487	556
m-Nitrotoluene ..	451	552	608	692
p-Nitrotoluene ..	503	618	666	751

It is found that no agreement is possible between $_{gas}P_2$ derived from different empirical relations so long as extrapolation is carried out to $\epsilon = 1$. From a reconsideration of the data in hand it appears that there is good reason to suspect the validity of extrapolation to $\epsilon = 1$ for the gaseous state. The empirical relations have been derived from results obtained from measurement on solutions and as such may be considered as applicable only so far as the liquid state is concerned. Once the transition from a liquid state to a gaseous state sets in there is no evidence to assume that the prolongation of the graph in that form is valid. On the other hand, it seems reasonable to assume that during transition the changes in the dielectric constant are unaccompanied by changes in the molecular polarization. This leads us to assume a horizontal portion on the graph $P_2 - \frac{\epsilon-1}{\epsilon+2}$ after the transition point is reached. This constant value of P_2 may be taken as $_{gas}P_2$.

Le Fèvre[4] has found that the dielectric constant of benzene, carbon tetrachloride, carbon disulphide and other liquids is nearly the same at the critical temperature of the respective liquids. This may be called the critical dielectric constant. Assuming the constancy of the critical dielectric constant a rough idea may be obtained about the magnitude of the dielectric constant when the transition is occurring at room temperature. For benzene the critical dielectric constant given by Le Fèvre is 1·35. The transition dielectric constant ϵ at temperature t° C. may be calculated from $\epsilon_t = \epsilon_c + \frac{d\epsilon}{dt}(t - T_c)$ where T_c = critical temperature, ϵ_c critical dielectric constant, and

$\frac{d\epsilon}{dt} = -0{\cdot}002$. The transition dielectric constant works out to be 1·88 for benzene at 20° C.

As a preliminary, the results of Parts[5] for solution in benzene of iso-propyl chloride, iso-propyl bromide, *sec*-butyl bromide, and *n*-butyl iodide are recalculated using the Sugden relation $P_2 = A - B\frac{\epsilon-1}{\epsilon+2}$ and evaluating P_2 for $\frac{\epsilon-1}{\epsilon+2} = 0{\cdot}2269$ ($\epsilon = 1{\cdot}88$). The electric moment calculated from this value is in good agreement with the value obtained by Groves and Sugden[6] from measurements in the gaseous state.

	Parts (recalculated)	Groves & Sugden
Iso-propyl chlorde ..	2·14	2·15
Iso-propyl bromide ..	2·18	2·19
Sec-butyl bromide ..	2·21	2·20
n-butyl iodide	2·07	2·08

When the Sugden relation is used for one solute in different solvents it is found that a value 1·7 for the transition dielectric constant yields concordant results. It may further be noted that when the relations of Jenkins and the author are each extrapolated to $\epsilon = 1{\cdot}7$ there is a general unification in the values obtained from the different relations.

$_{\infty}P_2$ *calculated from different relations*

Substance	Müller c.c.	Sugden c.c.	Author c.c.	Jenkins c.c.
o-Nitrotoluene ..	369	368	374	385
m-Nitrotoluene ..	451	456	466	472
p-Nitrotoluene ..	503	513	511	521

As a further test the results of Müller[7] for nitrobenzene, acetone and chlorobenzene in various solvents were recalculated using the Sugden relation extrapolated to $\epsilon = 1{\cdot}7$. The same was done for Jenkins' results for nitrobenzene.[3] The agreement between the recalculated values and those determined from measurements in the gaseous state is good enough to support the assumptions.

	μ recalculated	μ gas
Nitrobenzene[3]	4·19	4·23
Nitrobenzene[7]	4·21	
Chlorobenzene[7]	1·69	1·69
Acetone[7]	2·85	2·85

The results are of a preliminary character. Work is in progress and detailed calculations will be published later.

D. J. Davar.

Royal Institute of Science,
Bombay,
August 21, 1939.

[1] Hedestrand, *Z. physikal. Chem.*, 1929, **B2**, 428.
[2] Sugden, *Nature*, 1934, **133**, 415.
[3] Jenkins, *J.C.S.*, 1934, 482.
[4] Le Fèvre, *Trans. Farad. Soc.*, 1938, 1131.
[5] Parts, *Z. physikal Chem.*, **B7**, 327; **B12**, 312.
[6] Groves and Sugden, *J.C.S.*, 1937, 158.
[7] Müller, *Physik. Z.*, 1933, **34**, 689.

Photo-cells and the Measurement of Quantity of Light

The use of a photo-cell for measuring the quantity of light corresponds to the use of a galvanometer for measuring the quantity of electricity. If light from a source of candle power (C.P.) be allowed to fall on a photo-cell of area A for a time Δt, then it can be easily shown[1] that

$$S_q\theta = KA\frac{(C.P.)}{r^2}\Delta t = KQ \quad .. \quad (1)$$

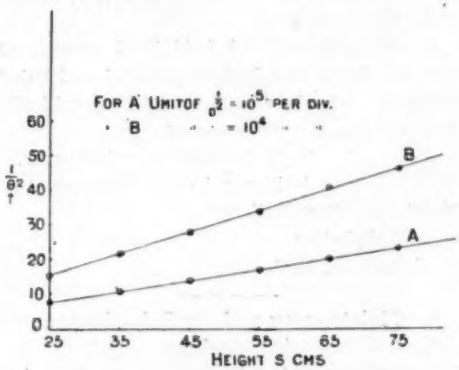
where S_q denotes the ballistic sensitivity of the galvanometer, θ the kick observed, r the distance between the photo-cell and the light source, Q the quantity of light and K is a constant.

We have determined the constant K by using two complimentary methods which may be called the light-flash method and the dark-flash method respectively.

In the light-flash method, a lamp of candle power 13·5 (15 watts) was allowed to fall from

different heights in front of a $Cu - Cu_2o$ photo-cell and the corresponding kicks in the galvanometer were noted. The duration of exposure Δt was calculated from the knowledge of the height s of the lamp above the photo-cell and the acceleration of the system (lamp, weights, etc.). θ^2 was found to be inversely proportional to s as shown by the graph A in the figure. We obtained for K the value of $44{\cdot}8 \times 10^{-6}$ coulombs per lumen-second.

In the other (dark-flash) method, the lamp was placed directly in front of the photo-cell and the continuous light falling on the cell was interrupted for small intervals of time Δt by allowing an opaque circular obstacle (of the same diameter as the aperture of the lamp-tube) to fall from different heights 's' in front of the lamp, the corresponding kicks ϕ of the galvanometer being noted. It was found that ϕ^2 was also inversely proportional to s (see graph B in the fig.).



From the theory of the ballistic galvanometer, it can be easily proved that the expression for the quantity of electricity passing through the galvanometer due to a current i in the circuit for a time Δt also holds for the quantity of electricity *not* passing through the galvanometer due to a break of the current i in the circuit for the same time Δt. Since the quantity of light falling on the photo-cell for a time Δt is proportional to the quantity of electricity passing through the galvanometer connected across it, it follows that the values of K obtained by both the above methods should be equal. We find, however, that the dark-flash method gives for K the value $55{\cdot}8 \times 10^{-6}$ coulombs per lumen-second.

To test this point further, the lamp was placed at different distances r in front of the photo-cell and the corresponding steady deflections of the galvanometer were noted. If S_c represents the current sensitivity of the galvanometer then

$$K'\left(\frac{C.P.}{r^2}\right)A = S_c\theta \quad .. \qquad .. \quad (2)$$

where K' is another constant.

We got $K' = 50{\cdot}6 \times 10^{-6}$ amperes per lumen.

It will be seen that this value of K' lies midway between the two values of K, obtained above, by different methods and agrees remarkably well with their mean.

D. V. GOGATE.
Y. V. KATHAVATE.

Physics Laboratory,
Baroda College,
Baroda,
September 4, 1939.

[1] *Ind. Jour. Phy.*, 1935, 9, 497.

Lethal Green Seedlings in Sorghum

MANY types of chlorophyll deficiencies have been recorded in sorghum. Albinos are common. Yellow seedlings are rare. Pale green seedlings occur with less frequency, and though in some types they die, in others they survive. In all the above cases the seedlings that are deficient in chlorophyll, being albinotic, yellow or pale green could be easily spotted as lethals by their colour as well as their reduced size. In this note we record the occurrence and inheritance of a type of lethal seedling, which, while it retains its normal green colour, shows considerable reduction in its growth and thus appears abnormal. This type of lethal green seedling, in which a deficiency in the quantity of chlorophyll is not apparent, was met with for the first time at the Millets Breeding Station, Coimbatore, in August 1938, in a pure line of *Sorghum caudatum*, Stapf received from Nigeria. This pure line was being grown for

two years at this Station and did not give such lethal seedlings, nor were such seedlings observed in other pure lines or segregating families. Presumably this occurrence is the result of a heterozygous mutation. In this pure line some

Seeds germinating on an earhead of cholam segregating for normal-tall and lethal green-short seedlings

seedlings, about ten days old were found to be very much stunted in growth and showed signs of dying. They were watched, and when counted, it was found that 187 of the total number died, leaving a surviving population of 609 normal seedlings. Earheads from twelve of these were carried forward and seedlings raised from them. Two came pure and ten of them segregated again giving obviously monogenic segregations, the total of the ten families being 1,374 normal green and 476 lethal green seedlings.

The lethal seedlings can be made out easily from their stunted growth about 4 to 5 days after germination. They show signs of wilting in about a week to ten days, and die when about a month old, when there are 5 to 6 seedling leaves. The first two leaves of the lethal greens do not differ markedly from those of the normal seedlings. The difference in size starts with the third leaf which in the normal is 3 to 4 times longer than that in the lethal. This difference is maintained in the subsequent leaves also. Similarly there is a marked difference in the height of the seedlings, the normals being 4 to 5 times taller than the lethals. The seminal root in both groups of seedlings about 30 days old, is about the same in length. The difference is in the number and size of the adventitious roots which are very few and short or rudimentary in the lethal greens. In some cases the adventitious roots are not developed at all in the lethal green seedlings.

The occurrence of a lethal seedling with no visible chlorophyll deficiency, indicative of its lethal nature, is very interesting. The lethal condition is brought about by an atrophy in the development of both the shoot and the root in the seedlings. The gene responsible for this type of lethal green has been designated cl. CL gives normal green seedlings and is a monogenic dominant to cl.

A photograph of a hybrid head germinated and showing *in situ* both the normal and lethal seedlings, about a month old, graphically demonstrates this phenomenon.

G. N. Rangaswami Ayyangar.
A. Kunhi Koran Nambiar.
Millets Breeding Station,
Coimbatore,
August 25, 1939.

Cleistogamy and Its Inheritance in Sorghum

The occurrence of cleistogamy in sorghum has already been recorded.[1] This phenomenon has been observed in *Sorghum papyrascens*, Stapf (*S. membranaceum*, Chiov.). An examination of all the pure lines belonging to this species grown at the Millets Breeding Station, Coimbatore, shows that all these (which are characterised by very long papery glumes) are generally poor in the extrusion of their anthers. Two of the pure lines were found to be cleistogamic and in them the edges of the lower floral and the upper involucral glumes were found to roll-in, tightly enclosing the upper floral glume and the floral parts. It has also been recorded that the

papery glume in Sorghum (gene py) is a simple recessive to the coriaceous glume of the *Durra* type (gene PY).[2]

In a cross between a coriaceous glumed type and a rolled-in edged papery glumed type, the F_1 was found to be coriaceous glumed with un-rolled edges. In the F_2 (A.S. 4916) a 12 : 4 ratio of coriaceous to papery glume was obtained.

TABLE I

Family No.	Character of Selection	F_3 Behaviour			
		Coraceous Glume		Papery Glume	
		Un-rolled edges	Rolled-in edges	Un-rolled edges	Rolled-in edges
A.S.5760	Papery rolled-in edges	..	..	..	Pure
A.S.5759	Papery un-rolled edges	..	..	Pure	..
A.S.5758	,,	..	..	Pure	..
A.S.5757	,,	..	..	Pure	..
A.S.5756	,,	..	..	33	11
A.S.5753	Coraiceous un-rolled edges	Pure	..	..	..
A.S.5750	,,	Pure	..	..	..
A.S.5748	,,	Pure	..	..	..
A.S.5747	,,	Pure	..	..	..
A.S.5754	,,	44	..	14	..
A.S.5749	,,	49	..	19	..
A.S.5755	,,	50	..	16	4
A.S.5752	,,	96	..	26	8
A.S.5751	,,	87	..	19	7

In the 4 group, 3 were with un-rolled edges and one with edges rolled in and cleistogamous. The actual figures obtained were 33 : 8 : 3.

A third generation of 14 selections was raised from the F_3 and their behaviour is given in Table I.

The totals of the three triple segregations are as follows:—Coriaceous 233, papery un-rolled edges 61, and papery rolled-in edges (cleistogamous) 19 — ($X^2 = 0{\cdot}12$ $P > {\cdot}90$)—a significant 12 : 3 : 1 ratio.

From Table I it will be seen (1) that cleistogamy is a consequence of the rolling-in of the edges in a papery glume, and its clasp of the contents; (2) that this rolling-in is a heritable character; and (3) that rolling-in manifests only in papery glumes (*py*) and not in coriaceous ones (PY).

A gene designated *gx* is responsible for the rolling-in of the edges of the upper involucral and lower floral glumes in sorghum. The gene could operate only on a papery glume (*py*). The concurrent presence of the genes *py* and *gx* results in cleistogamy.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.
Millets Breeding Station,
Coimbatore,
August 26, 1939.

[1] *Curr. Sci.*, 1936, **4**, 872–73.

[2] *Jour. Ind. Bot. Soc.*, 1936, **15**, 139–42.

A Problem in the Correlation of Pre-Cambrian Granites of Danta State

DANTA STATE in Rajputana had been surveyed by me[1] about a decade back, and it has been re-surveyed recently by Dr. Heron.[2] The fundamental difference in the interpretation of the geology of this State between Dr. Heron and myself is as follows:—

(1) Dr. Heron regards the fine-grained, non-porphyritic, banded, streaky and foliated pink 'granite-gneiss' as sheet intrusions, almost contemporaneous with the coarse-grained, porphyritic, homogeneous and white or cream-coloured 'Erinpura granite'—Post-Delhi in age. On the other hand, I had regarded the 'granite-gneiss' as a Post-Aravalli but Pre-Delhi intrusion, and older than the Erinpura granite.

(2) Dr. Heron regards the metamorphosed calcareous series (consisting of calc-schist, calc-gneiss, crystalline limestone and marble) as Ajabgarhs (the uppermost series of the Delhi System), whereas I had regarded this series as Aravallis.

The above two problems are inter-connected with each other. If we assume that the calc-series belongs to the Delhi System, there is no other alternative left but to regard the granite-gneiss to be a post-Delhi intrusion, and consequently contemporaneous with Erinpura granite, as both the gneiss and the granite show intrusive relations to the calc-series, and there has been no other acid phase of igneous activity after the Delhis and before the intrusion of Erinpura magma. Conversely, if we regard the two intrusions of the granite-gneiss and the Erinpura granite of Danta State to be of two different ages—the granite-gneiss belonging to the phase of the acid igneous activity after the Aravallis and before the Delhis, which has been observed in north-east Rajputana[3] then the calc-series must be regarded as Aravallis and not Delhis.

The granite gneiss forms an almost continuous mass of intrusion in the central portion of the State, extending from north to south. Some of the highest hills and ridges, like 'Sur', 'Dhamanawa', 'Ritaro' and 'Ghori', are made up of this gneiss. This granite-gneiss also extends further northwards along the Danta-Sirohee-Mewar Frontier, where it had been already mapped by Dr. Heron and his colleagues as Erinpura granite, before any of them studied it in its type area (Danta State). Intrusions of typical Erinpura granite are common in this central belt of granite-gneiss, towards its southern margin. The junction of Erinpura granite with the granite-gneiss is quite sharp. For example, at the southern extremity of the Danta State (north-west of Nedardi in the adjoining State of Bhalusana), a small *nala* marks the boundary of the granite (which is here characteristically of Erinpura type) and the granite-gneiss (which is here highly foliated). There is no gradation between the two types at this locality. Further north-eastwards of this locality (near hill 1932, S.E. of Navavas), a big tongue of typical Erinpura granite, from the main mass, cuts across a small ridge of finely foliated granite-gneiss, and there too no gradation is seen between the two types. Dr. Ghosh[4] who had surveyed the Umbri, Bhalusana and other smaller States at the southern boundary of the Danta State, also agreed with me in regarding this granite-gneiss to be definitely older than the Erinpura granite, as he had found the former occurring as inclusions in the latter. Dr. Heron himself regards the Danta State to be the "keystone in the arch" of the geology of Rajputana and northern Bombay.[5] For reasons indicated above, I am still of opinion that the granite-gneiss and the Erinpura granite of this State are not contemporaneous, and they represent two different intrusions. This conclusion will naturally affect very seriously the age of the calcareous series of Danta State and other sedimentaries of the adjoining areas, and ultimately the geological history of this portion of Rajputana.

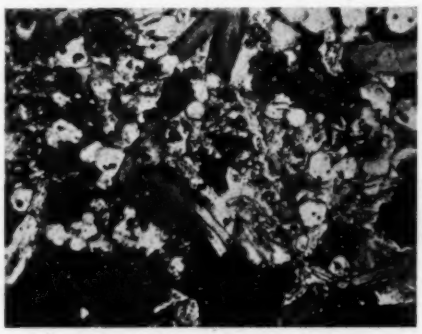
N. L. SHARMA.

Indian School of Mines,
Dhanbad,
July 20, 1939.

[1] *Q.J.G.M.M. Soc. Ind.*, 1931, III, 17–28.
[2] *Rec. G.S.I.*, 1938, **72**, 367–412.
[3] *Mem. G.S.I.*, 1917, **45**, 21.
[4] As cited by—*Rec. G.S.I.*, 1934, **68**, 70.
[5] *Rec. G.S.I.*, 1936, **71**, 69

Pseudomorphs after Leucite in the "Mica-trap" of Jharia Coalfield

WHILE studying the micro-sections of the 'mica-trap' from the Pathardih area of the Jharia Coalfield, I have found that its groundmass is made up of innumerable brownish turbid patches in case of the finer grained variety, and of water-clear patches in case of the coarser-grained one. These patches are strikingly polygonal or subrounded, and equidimensional. They are either isotropic, or are composed of weakly anisotropic material which is orthoclase felspar showing brush extinction, or spherulitic intergrowth of felspar and quartz. Sometimes cryptocrystalline quartz, calcite or limonite also forms a portion of the material of these patches. A few microscopic inclusions of opaque iron ore are observed arranged in the centre. The refractive index of the material forming these equidimensional grains is usually less than that of canada balsam. These patches cannot be originally of opal or of glass, as both the latter are amorphous and cannot show such hypidiomorphic outline. These grains occur in clusters in the groundmass and their refractive index is very low compared to that of apatite needles (present in the same slide), and is even lower



than that of canada balsam. Hence, these grains are not of apatite. The remarkable equidimensional sections of most of these grains and the absence of any longitudinal prismatic section amongst them in the whole slide, show that they were not originally of felspar or quartz, which may have formed by replacing the groundmass or as amygdules in it. It is, therefore, concluded that these crystals must have been of an isometric mineral—probably leucite—which has been replaced or altered by the felspathic material during the late magmatic changes undergone by the rock. These pseudomorphs are illustrated in the accompanying photomicrograph (ordinary light × 60), kindly taken by my friend, Mr. G. C. Chaterji.

N. L. SHARMA.

Indian School of Mines,
Dhanbad,
July 21, 1939.

A Yellow-flowered Variety of *Gynura crepidioides* Bth.

RECENTLY some notes were inserted in this *Journal* concerning the rapid dispersal of *Gynura crepidioides* in Asia. Now I can report the appearance of a yellow-flowered sport in the advancing population.

We received a duplicate of a sheet collected in China, Kwantung Prov., W. T. Tsang 20763, collected at Chong Uen Shan near Kau Fung, Loh Ch'ang district, "Abundant on dry, steep, sandy slopes, in a meadow, weed 1 m. tall, flowers yellow, odorless". The specimen which was not identified was collected before 1932 for Lingnan Herbarium, Canton.

In June Mr. C. N. A. De Voogd, Forest Officer of Buitenzorg Res., collected SW. of Buitenzorg, in the neighbourhood of Djasinga at about 125 m. alt. amidst normally coloured plants, also some plants conspicuous by their golden yellow heads, anthocyane apparently failing. No other distinctive characters against the normal red-brown flowered plants could be found.

I propose to name this yellow sport var. *lutea* nov. var.

In the Netherlands Indies the plant is still spreading eastward and is now also collected in Timor. I expect its appearance in Australia within a few years.

C. G. G. J. VAN STEENIS.

Herbarium, Buitenzorg,
Java,
September 4, 1939.

[1] *Curr. Sci.*, 1938, **7**, 21, 116, 385.

Polyrhachis Ants and Bacterial Symbiosis

WHILE working with the lac insect, *Lakshadia mysorensis* growing on *Shorea talura*, in Bangalore, India, I found the ant, *Polyrhachis rastella* Latr. v. *formicata* Em. intimately associated with it. All the species of Polyrhachis ants I have come across, build their nests underground while the above-mentioned ant lives entirely on trees. I found its nest not only on *Shorea talura* but also on mango and other trees where the leaves were just broad enough to be webbed or rather glued together to serve as small nests for this ant. It seems to have acquired the habit of living on trees in adaptation to an intimate association with scale insects. While surveying the possibilities of spreading itself in a lac plantation, where there was no scarcity of food in the form of honey excreted by the lac insects, I could not imagine why the ant was so scarce there. I never found two nests on the same tree or even a large one so that the greatest search had to be made to discover its nest. What natural factors check this ant from multiplying itself, has never been clear to me.

Polyrhachis formicata is further interesting as secreting a strong odour pleasant to the human nose. While the odour was characteristically allied to amylacetate, traces of a ketone and an amine as well were detectable. An organic chemist kindly suggested the smell might be that of amylformate since most ants produce formic rather than acetic acid. I asked a colleague in the Indian Institute of Science to prepare some amylformate for me which had an unpleasant smell. Many other esters were also tried but the odour of the ant *Polyrhachis formicata* approximated more to amylacetate than to any other ester tried. I also know another ant which produces the odour of ethyl acetate and where no appreciable smell of formic acid is formed so that the generalisation that all ants produce formic acid in some form is not justified.

Polyrachis menelas For. is also found in the lac plantation in Bangalore. It lives underground and as far as the lac cultivating area is concerned it may be looked upon as non-existing by which I mean to emphasise its degree of frequency. This ant emits a weak but appreciable formic acid odour.

Further three allied species of Polyrachis ants, found in Bangalore outside the lac plantation, were examined, each species having an odour characteristic to it and all living underground building very small nests, with about 200 individuals in each nest. All the species of Polyrachis I have studied line their nests with a web, the habit of living on a tree or underground making no difference in this respect.

A bacteriological examination of the intestine revealed the presence of rod-shaped bacteria in the midgut of *Camponotas ligniperda* and *Formica fusca*. I had from time to time also isolated the Bacteria in pure cultures of all these European and Indian ants, so that I was able to see there was no great morphological difference among them. The intestines of many Pentatomid bugs contain long bacteria but these bugs as a class, when compared with all the ants carrying symbiotic bacteria, show a variation, whereas all these ants exhibit a striking uniformity. So far I have examined only five species of Polyrhachis ants and it would be worth while extending such observations to other species. Should this note attract the attention of other workers on ants I shall be most grateful to receive say 5 specimens of each species of *Polyrhachis* ants preserved in 96% alcohol.

S. MAHDIHASSAN.

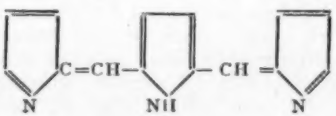
C/o The American Express Co.,
Berlin,
July 30, 1939.

REVIEWS

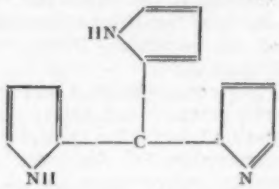
Die Chemie des Pyrrols, Vol. II. Part I (First Half). By Hans Fischer and Hans Orth. (*Akademische Verlagsgesellschaft*, m.b.H. Leipzig), 1937. Pp. xii + 764. Price 44 R.M.

The book has been written by one who has perhaps contributed most to the development of the subject in recent years, and the result is an exhaustive and masterly treatise of invaluable assistance to the specialist. After dealing with the simple pyrrols and their derivatives in the first volume of the series, the authors have devoted their attention in the book under review to the chemistry of the Pyrro-methines containing 2, 3 and 4 pyrrol nuclei respectively, and the colouring ingredients of the blood and the bile. The second half of Volume II has been reserved for a discussion of the chemistry of Chlorophyll and other related bodies such as the Imido-porphyrins which have now acquired considerable interest on account of their relation to the phthalocyanines. Although from the point of view of a systematic study of the pyrrol colouring matters, the division of the book into two such separate halves may not commend itself to many, the authors appear to have been prompted to adopt this method because of the subject of chlorophyll and its relations being at the time in a state of flux.

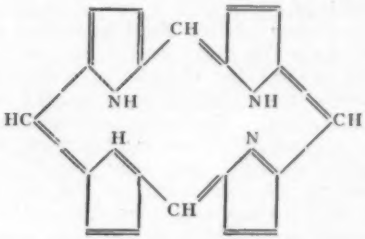
For the convenience of study the book has been divided into three parts. Part A deals with systems containing 2 pyrrol nuclei such as the simple pyrrol-methines and their numerous alkyl homologues and amino-, carboxy-, halogeno-, hydroxy- and other derivatives, and towards the end of the chapter an account of the syntheses of several interesting compounds of the phenyl-, furyl-, and thiophen-pyrryl methane types has also been given. In Part B two classes of what the authors call "trinuclear" products are described, *viz.*, (*a*) Linear Tripyrrenes of the structure,



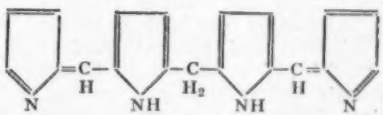
and (*b*) Prodigiosins, the red colouring matters of certain bacteria the molecules of which contain the three pyrrol nuclei bound to one and the same carbon atom, thus:



Part C is by far the most important part of the book. It treats of the tetra-pyrrol ring systems which again have been conveniently subdivided into two groups, *viz.*, (*a*) the Porphyrins in which the four pyrrol nuclei are arranged in the form of a ring,



and (*b*) Bilirubin and its allies in which the arrangement of the four pyrrol rings is a linear one:



The discussion of the chemistry of the Porphyrins covers 460 pages, *i.e.*, a good two-thirds of the volume. An excellent historical introduction to the study of porphyrins is given at the beginning, followed by a complete account of the various methods used in the syntheses of members of this group and a detailed description of the different types, *e.g.*, the Deutero-, Pyrro-, Rhodo-, Phyllo- and Atioporphyrins. The difficult subject of the chemistry of the

colouring matters of blood, Hæmin, Hæmochromogen and Hæmatin, has been treated in a masterly fashion and the various complex salt-formations of the porphyrins and their relations to these colouring matters have been explained very lucidly and skilfully. Under the second subdivision comprising the linear tetra-pyrrol systems, an exhaustive description has been given of the colouring matters of the bile—the "Bilins" and their various transformation products, and also of the synthetic Bilins, the so-called "Bilirubinoids".

The book is a comprehensive and masterly exposition of a complex but extremely fascinating subject and while the specialist would find it indispensable for his work in this field, it would also be most useful to the advanced student and teacher of Organic Chemistry. B. B. D.

Sinn und Aufgaben der Geschichte der Chemie. Dr. Erich Pietsch. (Verlag Chemie, Berlin), 1937. Pp. 33. Price 0·90 R.M.

The author of this short pamphlet of 33 pages urges the great importance and value to the present-day chemist of studying intensively the historical development of his special subject. He firmly believes that the study of chemistry from the historical standpoint is essential not only for a proper appraising of the merit of the chemists' work in initiating new lines of investigation, but most important of all, for understanding and appreciating the trend of human culture and thought in the past. Discussing in a highly philosophic strain what he considers to be the influence of the thoughts and ideas of men like Diderot, Holbach, Lamettrie, Alexander von Humboldt and others on scientific and general intellectual progress, the author has sought to expound his favourite theory that just as the study of history helps man to recognise the forces, direction and achievements of a past period, so the study of the history of chemistry should guide the chemist to the way back to the roots of our existence and thus enable him to become a spiritual participator in the creation of culture. Since chemistry influenced the thoughts of centuries in the past from the times of the alchemists to the present, we should, by occupying ourselves constantly with questions of the history of chemistry, be led inevitably to a truer understanding of the problems of development of the human mind. The author mourns the attitude of the scientists in the modern age, the "age of technique" as he terms it, in concerning themselves only with empirical investigations—an attitude that is mainly responsible for the degrading view that the human being is no better than a machine, and makes an eloquent appeal to chemists to emerge from their vaults of narrow specialisation and study the development of their science in perspective against the background of human culture of past periods. B. B. D.

Recent Advances in Plant Genetics. By F. W. Sansome and Philip. Second Edition. (J. & A. Churchill, Ltd., London), 1939. Pp. xii + 412. Price 18/-.

Since the first edition of this useful text appeared, in 1932, a large amount of work has been published in the field of plant genetics and some previously obscure points have been clarified. The junior author is now engaged in plant breeding in Egypt, wherefore it fell to Dr. Sansome to bring their book up-to-date. The treatment of the subject remains unaltered and the figures are the same except for one or two substitutions.

Chapter II, formerly titled "The Chromosome Theory of Heredity" is now called "Linkage" and has been largely rewritten. This chapter provides a helpful resume of the cytological and genetical basis of such fundamental phenomena as non-disjunction, cross-over values, chiasma formation, segmental interchange and genetic crossing-over. The ten linkage groups of genes in Maize are given alphabetically and chromosome by chromosome, also the smaller linkage groups in *Antirrhunum majus, Lycopersicum esculentum* and *Primula sinensis*. Twelve other species in which linkage groups are known are listed with the author and date. A considerable amount of the recent Drosophila work is used to explain crossing-over and chromosome map-making. There is included a section on the giant salivary gland chromosomes.

Chapter III on "The Constitution of the Gene" has been altered to include the newer work of Eyster, Demerec and Rhoades on multi-allelomorphs and mutable genes, as well as of Stern on somatic crossing-over. There are new sub-sections on mosaicism

in Maize, the size of the gene and the effects of X-rays.

The old section on "Variegation" has been taken from Chapter I and slightly expanded as Chapter IV. It now contains a clear and useful section on Chimæras. In the chapter on Polyploidy the author refers to the recent work on artificially induced somatic doubling by means of colchicine from which horticulturists are expecting great things.

The seven new tables which give the experimental data and theoretical ratios from breeding autotetraploids will be welcomed. Other Mendelian ratios and the statistical basis of selection are not given in this book because they have been adequately treated by others in recent texts. Accounts of the long continuous work in Crepis, Datura, Œnothera and Nicotiana are brought up to date.

Other new contributions in physiological and developmental genetics are touched upon, including incompatibility, colour development, growth hormones and vitamin content. There are no references to the researches on sugarcane and rice genetics being done in India, which are perhaps left to the domain of the sister volume on agricultural plant breeding.

A valuable innovation is a Key to Literature which gives important references, particularly those published since the first edition under appropriate headings. This is omitted from the table of contents. The Bibliography contains 241 new titles, all but 21 of which are published in English. It was noticed that some well-known Continental geneticists are now writing in English.

This book is a necessity for all those engaged in plant breeding and will save teachers and advanced students a lot of trouble in keeping abreast of the expanding frontiers of knowledge in this field.

EILEEN W. ERLANSON.

Principles of Palaeobotany. By William C. Darrah. A new series of Plant Science Books, Vol. III. Edited by Frans Verdoorn. (Published by the Chronica Botanica Company, Leiden, Holland), 1939. Price 7 guilders.

The author's purpose in writing this book has been to prepare a general introductory survey of the field of palæobotany. For this reason much of the controversial matter has been intentionally omitted. The book contains twenty-three chapters, each ending with a bibliography.

In an introductory chapter the author deals with the principles of biology and geology and the relation between botany and palæobotany. The different kinds of fossil plants are classified as petrifactions, incrustations, compressions, impressions and compactions or mummified plants. Of Chapter II, which gives a useful summary of the known methods of investigating fossil plants, about half is devoted to the examination of coal. Chapter XII is devoted entirely to the palæobotany of coal.

After a brief account of the Early Plant Records, many of which are problematica, there follows a series of chapters dealing systematically with the different groups of extinct plants. The classification of vascular plants into four large divisions, Psilopsida, Lycopsida, Sphenopsida and Pteropsida, is commendable for its simplicity and convenience.

Botanists will not easily agree with the author's reasons (p. 105) for the view that the northern Coal Measure flora lived in a temperate climate.

A chapter on the Mesozoic Flora discusses (among other things) the relative antiquity of some modern families of Pteridophyta, and then follows a discussion on the origin of angiosperms. The author strongly inclines to the view that the Cycadeoids were ancestral to the modern flowering plants. Consistently with this idea, which accepts the Magnoliales as being on the line of descent, he regards the woody arborescent habit as the original condition and the herbaceous as the derivative.

In introducing the subject of the mesozoic flora a rapid sketch of the physical conditions is given, laying stress upon the widespread diastrophic movements which must have affected the evolution of plant and animal life. While the date of the Laramide revolution in America may have been late Cretaceous (though even this cannot be regarded as certain), there seems no justification to continue to place the period of vulcanity in the Deccan in the Mesozoic. Recent palæobotanical evidence has now convinced most Indian geologists that the Deccan lavas were poured out in the beginning of the Tertiary era, as was originally believed a century ago, and this view has received much collateral support.

The Cenozoic floras dealt with are mostly American. From these the author leads up to the Pleistocene floras and discusses the physical conditions that have determined the distribution of the modern flora of the globe.

The theoretical chapter on Fossil Plants and Evolution discusses briefly a variety of questions such as the origin of species, the recapitulation theory, migration, adaptation and extinction. In the concluding chapter the author traces the main trends of plant evolution and, in traditional fashion, ends up with a genealogical tree of plant life.

Dr. Darrah has achieved the remarkable task of compacting in a space of 230 pages a mass of facts and theories from the entire field of palæobotany. This has been possible only by restricting the illustrations to the minimum and by making a rigorous selection in the text. The treatment of some aspects is inevitably cursory and a careful reader might find plenty of scope for criticism on individual points. But in a subject that makes such demands upon the imagination in the reconstruction of fragmentary evidence, probably no book is worth writing unless it bears the mark of the author's own views.

B. SAHNI.

Tree Growth. By Daniel T. MacDougal, B.SC., PH.D., LL.D. [Published by Chronica Botanica Co., Leiden (Holland) & I.S.S.D. (Macmillan & Co., Calcutta)], 1938. Pp. 240. Price 7 Guilders or about 15*sh*.

This book is the first of a new series of plant science books edited by Frans Verdoorn and published by the Chronica Botanica Co. of Holland.

Innumerable records of measurements of tree growth either as crops or as single individuals have been made for forest management purposes but such records are of little value to the plant physiologist in elucidating the detailed behaviour of trees while they are growing, the way in which the growth in different parts of the tree is correlated and the growth responses to the different environmental influences. From this point of view, a considerable amount of work has been done on the height growth of young trees, but the trouble and difficulty associated with the detailed recording of the diameter increment of stems and especially roots has been responsible for a relative paucity of information on this aspect of tree growth.

Dr. MacDougal has specialised for some twenty years on diameter increment measurements with the aid of various types of dendrometers,—instruments which are attached to the trunks of trees and which magnify the changes in diameter so that they can easily be read, or by dendrographs which record the diameter changes on a calibrated rotating drum of paper. This book collects together the results of a very large number of such measurements made on different species of trees growing under various conditions, and constitutes a valuable and comprehensive addition to our knowledge of the subject. In addition to his own researches, the author refers to previous work done on the subject by others and gives a list of bibliographical references at the end of each chapter. The book thus forms a fairly complete guide to dendrometrical work up to date, and will be of considerable value to research workers contemplating similar work. The book cannot be regarded as a text-book. It is difficult to read with maintained interest as it consists of pages upon pages of detailed description of the trends of diameter increment measurements in different species with brief notes of the particular points they illustrate. In some cases it is difficult to discover whether any particular point is being illustrated or whether the record is of typical or abnormal behaviour. As a book of reference for research workers one would have welcomed a summary at the end of each chapter giving the main conclusions drawn from the dendrographical records described, and the absence of an index makes it difficult for any one to find the information he is seeking without having to search through pages of dendrographical descriptions.

The book is, however, full of interesting information. After an introductory chapter giving a brief history of tree measurement there follows a chapter on methods of measurement in which apparatus for the continuous measurement of increases in both length of shoot and in diameter are described. The types of dendrometer used by the author are also illustrated. Methods of measuring the growth of roots are also mentioned.

The dendrographic record is a wavy line exhibiting daily and seasonal fluctuations that are often considerably greater than the true growth recorded. An interesting account is given of these variations which

have to be taken into account when interpreting the dendrographical records. The variations in size are directly correlated with the water relations inside the tree, as influenced chiefly by transpiration, but also by other meteorological factors. Notes follow on the inception of growth in pines, its relation to air temperature and its dependence upon growth substances produced in the buds. The typical growth cycle of the Monterey pine (*Pinus radiata*) is then illustrated by dendrographic records in its native habitat and correlated with local meteorological conditions and cambium temperatures and is followed by an interesting chapter on the phenology and relationship between radial growth and elongation of the shoots. Much of the author's work was done on the Monterey pine which is peculiarly suited to dendrometric studies on account of its exceedingly rapid growth in both height and diameter. The conversion of leaf products into woody cells is stated to proceed at a higher rate in this species than in any other known tree. Having given detailed accounts of the growth of pines both in their juvenile and adult stages chapters are devoted to the main features of growth of other species, the Sequoias, bald cypress, larches, spruces, Douglas fir and *Cupressus macrocarpa* among the conifers and *Fraxinus, Ulmus, Acer, Platanus* and *Fagus*, the Oaks, *Juglans, Populus*, and *Salix*, among the broad leaved trees with an interesting chapter on specialised trees including the tree-cactus *Carnegiea gigantea*, in which the daily reversible variations are, on account of the behaviour of the stomata in closing in response to increased intensity of sunlight, exactly the opposite to those of leafy trees, expansion taking place in the daytime and contraction at night. Root growth is also discussed in relation to the growth of the above-ground portions of the tree, and the correlation between the area of leaf surface, accumulation of surplus material and the amount of wood formation is described together with an account of some interesting experiments on the effects of artificial defoliation on wood production in conifers.

Space forbids mention of the many interesting physiological facts and theories mentioned in this comprehensive book. They are there if you can find them among the masses of experimental data. One cannot but admire the enormous amount of experimental work that is represented by this book. An account of little more than half a page may represent dendrometrical observations extending over five or even ten years, and some hundreds of such records are referred to.

The researches nearly all deal with growth conditions and species of temperate climates and a number of factors familiar to tropical workers as affecting plant growth are naturally not mentioned. Apart from this slight limitation the book is a valuable addition to our knowledge of the physiology of tree growth.

The printing and general format of the book are good, but considering the price, one would have expected a less flimsy binding.

M. V. LAURIE.

The Chemistry of Milk. By W. L. Davies, (Chapman & Hall, Ltd., London), Second Edition, 1939. Pp. xiv + 534. Price 25*sh.* net.

The early appearance of the Second Edition of the well-known volume on the Chemistry of Milk, three years after the publication of the first edition (reviewed in *Current Science*, 1935–36, **4**, 845), is a testimony to the warm appreciation extended to the first edition by the public. The author has utilised the opportunity of issuing the Second Edition for bringing the work up to date. This has necessitated revision and extension of certain portions of the volume. No alteration in the general plan of the book has been introduced.

The subject covered by the volume is one of great importance to everyone interested in human nutrition and for this reason, the book will have a wide appeal. The public analyst, the dairy chemist, the food technologist, the nutrition chemist, the medical man and the public health administrator, will find valuable information and useful data discussed in the volume.

To us in India, the book has a special interest. The appearance of the Second Edition happily synchronises with the author's appointment as the Director of the Imperial Dairy Research Institute in India whose dairy industry is notoriously backward. The wide experience and intimate and expert knowledge which the author has displayed in the volume, will no doubt be utilised in the solution of the intricate problems which confront the dairy industry in this country.

M. S.

Reunion Internationale de Physique-Chemie-Biologie Congress du Palais de la decouverte (Paris Oct. 1937) Chimie Organique. J. B. Bonino-Kurt H. Meyer –L. Ruzicka. (Actualites Scientifiques et Industrielles No. 723) (Hermann & Cie, Paris.) Pp. 55. Price 15*fr*.

This is a pamphlet containing a reprint of three addresses delivered in the Organic Chemistry Section at the Reunion Internationale in October 1937. The opening address is by J. B. Bonino on the Raman Spectra in organic chemistry than which it is difficult to find another experimental method contributed by physics that has proved more fruitful in application to classical organic chemistry. In the study of constitutional problems, study of the aromatic nucleus and heterocyclic compounds, in the identification and estimation of structural isomers, nature of bonds, phenomena of keto-enol, and chelation, Bayer's tension theory, the chemists possess in Raman spectra a new technique which takes them in many cases much farther than many of the older methods which were subject to various errors. The work of the Kohlrausch school, Dupont and Bourguel, Bonino and Manzoni, Krishnamurty and Sreenivasan is referred to.

The second address is by Meyer on the constitution of the crystallographic model and the texture of cellulose followed by a bibliography. Actually one cannot usefully discuss the constitution as during purification, alteration of certain groups in cellulose appears inevitable. Thus the carboxyl group ascertained by Schmidt and Ludtke is usually ignored in the proposed formula. Hess recently claimed that cellulose treated with great care does not contain glucose residue with free hydroxyl at 4th carbon atom. The author refers to Sponsler's work who established the first crystallographic model of the cellulose unit cell as ortho-rhombic.

The third address is a masterly exposition by L. Ruzicka on the architecture of polyterpenes which have 15–40 carbon atoms none with 25 or 35 carbon atoms being found in nature. The relatively rapid progress in the study of the polyprenes is due to the isoprene hypothesis of Wallach and the dehydrogenation methods. The isoprene hypothesis has been of special assistance in elucidating the structure of many biological products as phytol, squalene, α-carotene, vitamin A, sterins and of polyterpenes found in essential oils and resins. He then referred to resin acids, cadalin, eudalin and schematic cyclisation of farnesol to various sesquiterpenes except caryophyllene. The speaker closed his excellent exposition after referring to many difficulties of work on polyterpenes, procuring the compounds in sufficient quantity being an almost insurmountable obstacle. In the active discussion that followed Dupont and others emphasised the valuable results that may be obtained by application of Raman spectra to synthetic and analytical work on polyterpenes. With small quantities of substances, with complicated molecules in which many lines may be obtained, the examination of the crystals or of a film according to Langmuir is already expected to considerably facilitate the work.

B. SANJIVA RAO.

An Introduction to Chemistry. By John C. Hogg. (Oxford University Press, Bombay), 1938. Pp. 365. Price 8/6.

This elementary text-book stresses the historical approach and gives a cultural setting to an ancient science, which seems to be the object of the writer. Only a limited number of topics have been taken for study but these have been described in detail. The chemistry of metals and many non-metals like members of the halogen family have been completely omitted. Particular emphasis has been laid on the gravimetric aspect and practical details regarding demonstration experiments have been given. The method of writing equations to represent chemical reactions has been well dealt with. This book can be used with advantage by those teachers who lecture to the S.S.L.C. classes and the Junior Intermediate sections of the Indian Universities, since they will only be able to provide the students with the slow and steady growth of knowledge.

M. SESHAIYENGAR.

Chemistry *sans* Dalton

An Introduction to Crystal Chemistry. By R. C. Evans. (The University Press, Cambridge), 1939. Pp. xii + 388. Price 18*sh.*

IN the years immediately following Laue's epoch-making discovery, and the *bahnbrechende* investigations of W. H. and W. L. Bragg in 1914 on the application of X-rays to the study of the structure of solids, interest was chiefly directed to a close study of the structures in themselves. It was not long however before it was realised that the arrangement of the 'bricks' into geometrical patterns in different crystals was governed by general laws and had a wider significance both for the physical and the chemical properties of the substances. The work of V. M. Goldschmidt in 1926 on the morphology of ionic crystals can be truly said to lay the foundation of this modern 'crystal chemistry'. Next in 1929, L. Pauling codified in the form of five rules the general principles underlying the structures of all ionic crystals. Since then steady progress has been made in the subject, and the excellent periodical reviews under the authorship of J. D. Bernal and others, appearing in the *Annual Reports* of The Chemical Society, must be familiar to, at least all chemists.

A connected account of this very promising and highly significant phase of modern physical science, is now made available in the compass of a complete book by Dr. R. C. Evans. R. C. Evans has made the subject doubly interesting by eschewing the drier details while critically appreciating the essential developments, and by wielding a facile pen that goes to make an attractive style of writing. The following excerpts culled from different portions of the book, indicate the fare in store for the reader. "Ideally, crystal chemistry should enable us to predict and synthesise chemical compounds having any desired combination of properties whatsoever." "In solids it is the exception rather than the rule for the molecule to have a discrete existence." "The picture of the sanctity of the molecule has created a quite false impression of the importance of the classical laws of chemistry. The Daltonian laws of constancy of composition and of simple stoichiometric proportions now appear as trivial and insignificant consequences of geometrical requirements rather than as profound and fundamental expressions of the laws of nature. The conception of valency, too, so successful in organic chemistry, has been widely, and sometimes blindly, applied in fields altogether outside its scope, until, on chemical grounds alone, it has become clear that certain classes of compounds refuse resolutely to conform to accepted chemical principles." "It is ultimately of little importance whether a given body is described as a chemical compound or not, provided that its structure is known, and the wider significance of that structure appreciated."

In the first three opening chapters of the book, which constitute Part I, the various types of binding forces that hold together a crystal edifice, namely, the metallic, ionic or polar, homopolar or co-ordinate, and the residual or Van der Wal's are discussed, and their quantitative treatments outlined in their essentials. Finally, there is indicated the scope of Bloch's zone theory for unifying the various *ad hoc* treatments of binding forces, and thus leading to a general theory of the solid state.

All the chemical elements and compounds can be classified, although not rigidly, in terms of the different types of binding forces and therefore indirectly in terms of the crystal structures which they possess. The second part of the book on "Systematic Crystal Chemistry" is based on this classification. The first two chapters on metallic systems, which include lucid accounts of the disorder to order transformations leading to the formation of superlattices, and the Hume-Rothary rules for the formation of 'electron compounds', serve to emphasise the great importance of pattern sites, and the need for a wider conception of chemical combination. After a brief chapter on the limited number of more or less purely homopolar structures, the reader is led on to a series of four chapters on ionic compounds. The concept of 'electro-static valency' as the ratio of the charge on the ion to the number of neighbours co-ordinating it, gives a convenient basis for further classifying the ionic crystals into 'anisodesmic', *i.e.*, those with discrete groups in the structure, 'isodesmic' where no discrete groups occur, and 'mesodesmic' structures in which the strongest

binding has an electrostatic valency strength one half of the charge on the anion. The super-polarising power of the H^+-ion arising from its vanishingly small size, and the consequent anomalous behaviour of compounds containing hydrogen, entitle them to a separate chapter: in this, is also included, a succinct account of the allied topics of the structures of liquids, liquid crystals, and glasses. The descriptions of the various ionic crystals, and in particular the 'defect' structures, with either a statistical distribution of different ions among crystallographically equivalent sites, as in the spinels with 'equipoint' structures, or with incomplete lattices as in Al_2O_3, and Pyrrhotite, leave the classical chemist searching in vain for a trace of his molecule, and thereby disillusioned about the 'sanctity' of the same.

In the last chapter on molecular lattices, where the bonding is generally by residual forces, the concept of the molecule is restored to its true and proper place. Here the shape of the individual molecules plays an important rôle, and the structures can be broadly classified according to the molecular shape, and the type of inter-molecular force, apolar, polar or ionic. The number of such crystals whose structures have been completely worked out is not large, but to the extent progress has been made, significant informations regarding the precise molecular configurations, and intra- and inter-molecular bondings, have been obtained, which are otherwise beyond the scope of direct chemical experimentation. A striking example in this connection is the work of J. M. Robertson on the phthalocyanines, for under the favourable circumstances prevailing in this case, he has achieved the first absolutely direct analysis of an organic molecule, and one which does not involve even the assumption of the presence of atoms. Indeed this analysis goes one step further, and the chemist has to stand corrected regarding the distribution of valencies in the molecule. With other complex molecules even the incomplete X-ray analysis at present possible, is not without profit, as it has frequently enabled important conclusions to be drawn about molecular structure merely from the cell dimensions, and the space group, *e.g.*, the sterols and sugars.

The printing and get-up of the book are excellent: just one print mistake has been detected on page 342, line 21, where 'molecular' has obviously to be corrected to 'molecule'. For original sources a choice selection is given, which includes almost all the summarising articles, wherefrom fuller and complete references can be easily had. The book is moderately priced and must find a place in any science library.

M. A. G. RAU.

Modern Psychology grapples with Man

Introduction to Psychology. By E. G. Boring, H. S. Langfeld, H. P. Weld and Collaborators. (John Wiley & Sons, New York; Chapman & Hall, London), 1939. Pp. 652. Price 15*sh.*

READERS of *Current Science* perhaps know that the three distinguished psychologists, E. G. Boring, H. S. Langfeld and H. P. Weld have already published "Psychology: A Factual Text-Book" with the help of collaborators, and a revised edition of that work now appears under a new title, because, "This new book is so much more than a revision of the old that we have given it a new title" (p. vii, Preface). New chapters, new collaborators, revision and rearrangement of chapters, occasional expansion and condensation of contents of certain chapters should be deemed sufficient justification for the advent of a new book.

Not for these and many other features that may become apparent to those who peruse the volume will it be welcomed. The book commences with a specific question: What is man? The opening chapter is entitled "The Nature of Man". The concluding chapter repeats the title, and has a thick-face type sub-heading or commencement *Da Capo* "as at the end of a passage of music" (p. 627). Without keeping anyone in suspense, the question is almost immediately answered. What is man? "A man", the distinguished authors answer, "is a mass of protoplasm moving about on the face of the earth". What is the chief characteristic of man? His conduct is dominated or right through governed by needs. To satisfy countless needs, he "acts, learns, thinks and perceives". Let the matter be clinched. What is a person? *Needy protoplasm with*

all these properties. (Italics mine.) The authors tell us that modern psychology attempts an outline of man's sketch on the lines indicated. A complete picture of man understood as needy protoplasm is attempted in the course of 18 chapters. There is no need to repeat the contents at any length. Man is a mass of protoplasm. He is thrown amidst an environment. He should adjust himself to it or refashion it to suit his convenience. He has needs. Satisfaction of the needs is the goal of existence. He thinks, learns, and acts in the interests of the satisfaction of the needs.

One must be grateful to the authors for a frank statement of the conclusion of modern psychology on the problem of man without any camouflage. Out of the plenitude of the reviewer's unconcealed gratitude is the title of this notice chosen. I would like frankly to frame the straight question: Has modern psychology ushered in with a flourish of trumpets, propaganda and advertisement after all grappled with the problem of man? *Introduction to Psychology* renders the answer that Man is a mass of needy protoplasm. I am unable to see how this answer is claimed to have been given by "modern psychology". Modern biology may well define man as a mass of protoplasm. Man may further be defined as a bundle of nerves and neurones. It would be impossible to forget the definition of man as a *consolidated colony of cell bodies and chromosomes.* Sex-urge, food-urge, fear, instinct of self-preservation are all shared by animals along with man. Animals are undoubtedly masses of needy protoplasm too. The *reductio ad absurdum* of the view of man upheld by Boring, Langfeld and Weld would be: Hitler is a mass of needy protoplasm securing satisfaction of his needs in his own way! Sir C. V. Raman is a mass, again, of needy protoplasm securing satisfaction of his light-needs in his own way!

I am afraid there is absolutely nothing in the volume under notice for students of Indian Psychology to enthuse over. Behaviour of mankind in different zones of civilization is by no means a rational or scientific guarantee of the correctness of definition that man is a mass of protoplasm. Heredity, and Environment, Matter and Energy are not alone sufficient to explain adequately the facts and phenomena of life. The contention is perfectly understandable that for purposes of verification under the conditions imposed by laboratory investigation and the concomitant qualitative and quantitative analysis, nothing of man is available except his overt behaviour, or adjustment to environment, and that from such behaviour or adjustment his motivation is to be inferred. In receiving and registering sensory stimuli emanating from external Reality and impinging on the organism, and in the execution of correct and efficient responses, neuromuscular, protoplasmic mechanism is the only go. So far one can easily follow the modern psychologists. From this there is an unmistakable *non sequitur* to the view that man is nothing more than protoplasmic stuff or mass of protoplasm. Failure to realize the nature and consequences of this palpable *non sequitur*, deliberate or unconscious or unwitting, is the bane of Modern Psychology of the type presented in the volume before me. According to Indian Psychology, man is first self (*Atman*). In addition to the well-known sensory-motor mechanisms or organs (*Indriya*) there is a specific, special inner sense (*Antah-karana*), which is the *mind.* Psychology would cease to be an independent science if mind is ignored or denied under cover of protoplasm. Psychologists *a la* Othello would lose occupation if man were nothing more than protoplasm. The mind (*Manah*) is differentiated into *Manas, Buddhi, Ahamkara* and *Chitta. Contact of self with mind* is the root-cause of all conduct, emotion and intellect, or of volition, emotion and intellection or cognition. Modern Psychology is a mysterious mixture of Anatomy, Physiology, Biology and Neurology. What then is Psychology proper? The book contains no answer. The distinguished authors, however, have issued an attractive volume.

R. NAGA RAJA SARMA.

INDUSTRIAL SECTION

Chemical Cotton

THE term 'chemical cotton' is used for chemically cleaned cotton, *i.e.*, cotton from which substances other than cellulose have been completely removed. Chemical cotton is nowadays used as a basic raw material for the manufacture of a large number of articles, such as artificial silk, staple fibre, photographic films, transparent paper, plastics, gun cotton and lacquers.

The term 'chemical cotton' is likely to convey the impression that it is made from ordinary staple cotton which is generally used for manufacturing textile goods. This is not the case. In practice cotton linters, *i.e.*, those short fibres which are left on the seed after the ginning operation has removed the longer fibres and which do not possess any worth for textile processing, form the chief raw material of the chemical cotton industry. These fibres, though short in length, possess the same high grade cellulose as the longer fibres. In addition, chemical cotton may also be manufactured from cotton waste, old rags, waste yarn and stained cotton by employing suitable processes of cleaning.

Linters were unknown till about the end of the nineteenth century, when delinting of cotton seed was undertaken in America, primarily with a view to preparing the seed for extraction of oil. Subsequently these linters were found to possess an economic value of their own, and their production increased very rapidly. To-day the annual production of linters in U.S.A. exceeds 1,000,000 bales of 500 lbs. each.

In India the production of linters was practically unknown till about 1935, when the Indian Central Cotton Committee took up the problem. It was found that a number of varieties of Indian cottons delivered, on ginning, seeds which could be delinted subsequently. About this time a few oil mills started delinting the seed to improve their oil production, but the linters obtained were not put to the best possible use. The number of delinting machines installed in oil mills and ginneries has steadily increased and we now produce a few thousand bales of linters annually. In the absence of any cellulose industry in this country, however, these linters have to depend solely on the foreign purchaser, who is somewhat exacting in his specifications. Recently, it was reported that several hundred bales of linters were lying idle for want of purchaser, presumably due to the ungraded quality of these linters and the severe competition from U.S.A. where the industry has been highly organised in the last 15 years.

It is well known that shortly after the last Great War America was obliged to standardise linters on account of the enormous growth and the special importance of this industry. If we wish to utilise our raw materials to the best possible advantage, it is necessary that we should adopt the most up-to-date methods of producing and grading them, so that they compete with the foreign materials. In this respect the steps already taken by the U.S.A. should prove a valuable guide, and while applying them to our peculiar conditions, we should try to improve upon them wherever possible. In view of the importance of this problem, it has been undertaken by the Indian Central Cotton Committee and is at present being worked out at its Technological Laboratory.

It has been estimated that the potential supply of Indian linters which can be reached in the near future, is well over 60,000 bales. This supply can be augmented later if the demand is strong. For securing a steady market at an economical price it would be necessary to standardise this supply. Furthermore, it would be highly desirable that these linters should be cleaned chemically in this country so as to create a new industry which would supply the needs of several chemical and manufacturing industries. The necessity of producing standard types of chemical cotton is even greater than in case of raw linters, as the requirements of the former are more exacting than those of the latter. In view of these reasons an experimental plant for producing chemical cotton has recently been sanctioned by the Indian Central Cotton Committee. It is hoped that this pilot plant will not only prove a forerunner for industrial enterprise for the manufacture of chemical cotton in this country but also for the development of several industries which require chemical cotton as a base.

N. A.

Industrial News and Notes

We wish to invite the attention of our readers to a new feature in the Science News Section, which will provide information relating to technical advances secured in the domain of chemical plant, and constructional materials, industrial machinery and equipment and control devices. In this connection we wish to acknowledge with thanks the ready and courteous co-operation extended by the various research organisations and industrial firms in Great Britain and elsewhere who have willingly placed at our disposal, information relating to their research activities and literature pertaining to their technical products.

CENTENARIES

Duncumb, John (1765–1839)

JOHN DUNCUMB, an amateur British agriculturist, was born at Shere, Surrey, in 1765. Having received his early education at Guildford, he joined the Trinity College, Cambridge, and came out B.A. in 1787 and became an M.A. in 1796. For four years from the date of his graduation, he was editor of *Hereford journal*. In 1791 he entered holy orders and held different benefices from time to time but never changed his residence from Hereford.

His Contributions to Agriculture

Charles, the eleventh Duke of Norfolk, who had extensive estates in Herefordshire engaged Duncumb to write a detailed history of the country on payment of two guineas a week and travelling expenses to tour the country for collecting materials. Two volumes were published till 1815, when the Duke died. The book was completed by others as late as 1882. But the journey for the collection of materials made Duncumb a familiar figure in the county and gave a distinctively agricultural turn to his interests.

He became Secretary to the Herefordshire Agricultural Society from its formation in 1797. He published two books on Agriculture: *Essay on the best means of applying pasture lands, etc., to the production of grain and of recovering them to grass* (1801) and *General view of the agriculture of the county of Herefordshire* (1805). The latter received consideration by the Board of Agriculture and Internal Improvement.

Duncumb died at Hereford September 19, 1839.

Gee, Samuel Jones (1839–1911)

SAMUEL JONES GEE, a British physician, was born in London September 13, 1839. Having received his early education in a private school, he entered the University College, London, in 1857 and became M.D. in 1865. He became a fellow of the Royal College of Physicians in 1870.

His Career

He became house surgeon at the Hospital for Sick Children in Great Ormond Street, London, in 1865 and changed over to the St. Bartholomew's Hospital in 1868, where he remained in various capacities till death. He taught successively morbid anatomy, pathological anatomy and medicine. He was appointed physician to George, Prince of Wales, in 1901.

His Contributions

Gee became one of the authorities of his time on pediatrics. He wrote nearly fifty papers, most of which appeared in the *St. Bartholomew's Hospital reports*. The earliest papers which were on chicken-pox, scarlet fever, and tubercular meningitis, appeared in Reynold's *System of medicine* (1866–68).

Gee published two books: The first *Auscultation and percussion, together with other methods of physical examination of the chest* (1870) attained the dignity of its sixth edition in 1908. It is regarded "at once the most exact and the most literary account of its subject in English". Gee's other book, *Medical lectures and aphorisms* (1902), contained fourteen essays and 272 aphorisms and it reached its third edition in 1907.

Gee delivered three endowed lectures at the Royal College of Physicians: Galstonian lectures (1871) *On the heat of the body;* Bradshaw lectures (1892) *On the signs of acute peritoneal diseases* and Lumbeian lectures (1899) *On the causes and forms of bronchitis and the nature of pulmonary emphyseme and asthma.*

His End

Gee was librarian of the Royal Medical and Chirurgical Society from 1887 to 1899 and had a wide knowledge of books. But he was essentially a lonely man, with no hobby to bring him into familiar contact with his fellow-men. Happy in his domestic life and with his books, he preferred to remain at home when each day's work was done.

Gee died suddenly of heart failure at his daughter's house at Keswick August 3, 1911.

S. R. Ranganathan.

ASTRONOMICAL NOTES

Eclipses.—A total eclipse of the Sun will occur on October 12; but no phase of the eclipse will be visible in this country. The path of totality lies entirely in the Antarctic regions. On October 28, there will be a partial eclipse of the Moon which will also be invisible in India. The magnitude of the partial eclipse will be 0·992 with the Moon's diameter as the unit.

Planets during October 1939.—Both Mercury and Venus will be evening stars and will be low down in the western sky at sunset. Mars can be seen on the Meridian in the early part of the night; it is moving away from the Earth and getting fainter, the stellar magnitude decreasing from $-1{\cdot}0$ to $-0{\cdot}4$ during the month. Jupiter will continue to be a bright object favourably situated for observation for the greater part of the night. Likewise will be Saturn, which is in opposition to the Sun on October 22. It will be at its maximum brightness magnitude 0·1 (nearly equal to Vega), about the middle of the month. Uranus is near the western border of Taurus and is slowly moving in a retrograde direction; it can be seen on the meridian about a couple of hours after midnight. On October 29, there will be a close conjunction of the planet with the Moon, the angular distance between the two at the time being a little more than a degree. Neptune is a morning star and with some optical aid, can be located as a faint object lying midway between the two fourth magnitude stars ν Leonis and ν Virginis.

Comets.—An unexpected Comet was discovered by M. Rigollet on July 28, in the constellation Taurus. It was fairly bright (of magnitude 8) at the time, and diffuse with a central condensation but without a tail. According to the orbit computed, the time of perihelion passage appears to have been 1939 August 9. The Comet is receding from the Earth and becoming fainter. Dr. Cunningham suggests that this Comet is probably identical with Comet 1788 II.

Prof. Kaminsky of Tashkent has reported the discovery on July 24 of another new Comet in the constellation Aquila. The object was bright at that time (of the seventh magnitude), and moving rapidly in a south-easterly direction. The number of Comets, discovered so far this year, is nine.

T. P. B.

Magnetic Notes for July, 1939

MAGNETIC CONDITIONS.—The days (G.M.T. midnight to midnight), are classified *quiet*, *slightly* disturbed, *moderately* disturbed, *greatly* disturbed, or *very greatly* disturbed, on the basis of a critical examination of the Declinition, Horizontal Force and Vertical Force magnetograms of the Alibag Magnetic Observatory, Bombay. The oscillations in the different elements on a particular day as also the deviation of the day's magnetograms from those of a *selected quiet* day during the month are taken into account in assigning the character for the day in question.

The month of July, 1939, was magnetically more active than the previous month. During the month of July there were 9 *quiet* days, 14 days of *slight* disturbance, and 8 of *moderate* disturbance. There were no days of *great* disturbance. The magnetic conditions during the month were quietest on the 9th and most disturbed on the 4th. The characters of individual days of the month are given below in tabular form.

Dates of the month of July 1939	Quiet days	Disturbed days	
		Slight	Moderate
	6 to 10, 13, 18, 30, 31	1, 2, 12, 15, 16, 17, 19, 22, 23–25 and 27–29	3, 4, 5, 11, 14, 20, 21 and 26

Magnetic Storms.—During July 1939, 5 *moderate* storms each with a prominent 'sudden commencement' in all the three magnetic elements were recorded, as against 3 (2 moderate and 1 great) during the corresponding period last year. The mean character figure for the month was 0·97 according to the international scheme (0 = quiet, 1 = slight disturbance, 2 = larger disturbance) as against 0·52 for July of last year.

M. R. RANGASWAMI.

The Cultivation of Cinchona in India

IT appears probable that we shall soon be having a big development in the cultivation of cinchona in India. Towards the end of the year 1937 it may be recalled that the Imperial Council of Agricultural Research, set on foot an enquiry into the prospects of cinchona cultivation in India and appointed Mr. A. Wilson, Deputy Director, Cinchona, Madras, to conduct the enquiry and also associated with him Dr. T. J. Mirchandani, Agricultural Chemist, Bihar, as Soil Chemist. The Report of these officers which has just been published as Mis. Bulletin No. 29 of the Council, goes fully into the subject, giving an account of the present situation and prospects and an equally interesting survey of the nature and extent of the efforts in the past. It may not be generally known that India is already a fairly large producer of quinine from locally grown cinchona bark and that in the past it was producing much larger quantities. The present annual production is put down as some 70,000 lbs. of quinine; until about the year 1880 she was a much larger producer, the estimated quantity of bark per year at that time being as much as 950,000 lbs. or an output of nearly 2 lakhs of pounds of quinine—facts which amply demonstrate that India has the soil and climate suitable for producing a large quantity of her requirements of the drug. This important factor, *viz.*, India's requirements, is estimated variously; the author estimates it at 6 lakhs of pounds, he also refers to other authorities who estimate it at 12½ lakhs of pounds or over twice the first estimate. This is further complicated by the fact that in reality India is consuming only 210,000 lbs. per year or only a third of the lesser of the above two estimates. An account is also given of the difficulties which the Government met with in disposing of their stocks; consumption fell from 80,000 to 60,000 lbs. even though prices became cheaper by 30 per cent. and the demand could not be increased even when the stock was offered for sale at a big sacrifice in price. Altogether we cannot help thinking that this matter of the quantity which India will absorb is decidedly obscure and needs to be clarified. We wish also that a statement had been furnished to show the consumption per year for a period of, say, the last 10 or 15 years. Anyhow the report takes 210,000 lbs. of quinine as the annual requirement; of this quantity local production supplies at present 70,000 lbs. and the remainder is imported. The immediate objective therefore is to grow enough cinchona in the country to produce this 140,000 lbs. of quinine that is now imported. The report further envisages the need for producing the much larger quantities referred to above and contains suggestions to that end also.

Land considered promising for cinchona cultivation in many parts of India, notably the planting districts of South India, Assam, Bengal and Orissa, and the Andaman Islands have been surveyed, soil analyses and profile studies made, and the requirements in this regard discussed. Altogether an area of some 38,000 acres have been specified as suitable and additional tracts are indicated for further similar inspection, if a much larger production should be contemplated, though for the planting programme of twelve years at the rate of 3,333 acres annually stated as required for the latter larger production, this 38,000 acres appear sufficient. Government, planters and small holders are all suggested as suitable agencies for the growing of the plants. We may point out in this connection that no information to show what money return can be expected from the cultivation of cinchona is available in the report although this is an all-important factor, at least as far as the private planter is concerned whether large or small. The cost of production is however given in detail; a statement of the prices paid for bark, or the unit prices that have ruled for the last ten years or so will have greatly added to the usefulness of the report. We should also like that analyses had been given of the soils of certain Anaimalai estates where bark with a high quinine content of 11% was being produced, and likewise of the soils of the Tavoy plantations which are stated to have been a disastrous failure although the area was selected by one of the greatest experts in cinchona.

The species *ledgeriana* is the one recommended to be grown. It is gratifying to learn that 72% of the cinchona grown in India at present is *ledgeriana*, and that among these some extraordinarily good areas may be seen. The need for research is emphasised on the famous Java model and a strong plea put in for a research station for isolating better performing strains of *ledgeriana*, for their multiplication as plants on their own roots or grafted on to *succirubra* stocks, for much nursery technique and so on. Such a station is in our opinion long overdue.

Much has been accomplished even as the result of grafting the *ledgeriana* on to the less-exacting *succirubra* in Java, a comparatively easier line of work which we are told is being done with great facility by ordinary coolies trained for the work, at the rate of some 300 to 500 grafts per day for a set of two coolies; it should be possible to undertake this work at least straightaway on the present Government plantations themselves. It is stated that this was attempted but was not persisted in. The point is further stressed that unless this better species and better yielding types among it are grown it will not be possible to reduce the cost of production. This cost of production will probably be the rock on which schemes of expansion and continuance will split; motives of self-sufficiency are not likely to stand the strain of the ever-present and insistent claims for economy, especially if large supplies of cheaper quinine should be available from Java or other foreign sources. The lines of expansion indicated in the report are cautious and sound; we hope suitable action will soon be taken to give effect to the recommendations.

A. K. Y.

SCIENCE NOTES AND NEWS

Prof. Sir S. Radhakrishnan.—At the request of Pandit Madan Mohan Malaviya, Prof. Sir S. Radhakrishnan has agreed to accept the Vice-Chancellorship of the Benares Hindu University. Sir Radhakrishnan occupies a unique position in the academic world. He is the Spalding Professor for life of Eastern Religion and Ethics at Oxford. He is also the George V Professor of Philosophy and President of the Post-Graduate Council in Art in the University of Calcutta. He is a distinguished member of the International Committee on Intellectual Co-operation at Geneva. He was the Vice-Chancellor of the Andhra University for a period of five years. Recently he has been elected a member of the British Academy, being the first Indian to be honoured by that body.

"For the past ten years, Sir Radhakrishnan has been unweary in the service of the Motherland. He has interpreted the culture of India to the east and the west as few scholars have done so far. As a Lecturer on Comparative Religion at Chittagong and as Hibbert Lecturer in London, Sir Radhakrishnan has been an unrivalled exponent of Indian thought and culture. It is the good fortune of the Benares Hindu University that it has been able to secure the services of this savant."

The appointment of Sir Radhakrishnan will give satisfaction to all those who are interested in the progress of this all-India institution. The Benares Hindu University, which was founded in 1916 as the first residential and teaching university in India, has made remarkably rapid development.

* * *

Excavations at Sopara.—Excavations carried out at Sopara, Bombay, early this year by the Archæological Survey of India, have brought to light the remains of a complete brick built Buddhist stupa of the second century A.D. with its drum, 275 feet in circumference and 4' 2" in height, as well as substantial remains of the dome of the stupa now rising 19 feet above the six feet wide terrace around it. Although from the base of the drum, the apex of the surviving dome stands to a height of 23 feet, there is no doubt that originally the stupa must have stood about 100 feet high.

Fortunately, the drum of the stupa survives in its entirety and from its circumference of 275 feet, it may be said to be among the largest of its kind yet discovered in Western India.

Excavation of the open area directly to the south and south-west of the base of the stupa drum has revealed several brick platforms roughly square in plan, side by side with circular brick basements. It is not improbable that these structures attributable to the fourth and fifth centuries A.D. represent the remains of smaller votive stupas, usually dedicated by devotees visiting the main stupa.

* * *

Isolation of Xanthyletin from *Luvunga Scandens* Ham.—The fruit of the plant called Kalka in Bengal has been examined by Spath, E., Bose, P. K., Dobrovolny, E., and Mookherji, A. (*Ber.*, 1939, 72, 1450). They obtained xanthotoxin luvangetin and a mixture of cumarins from which xanthyletin (m.p. 131–131°·5) has been isolated identical with that which Bell and Robertson found in *Xanthoxylum Americanum* (*J.C.S.*, 1936, 1828) also belonging to the Rutaceæ family.

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***Stevia Rebaudiana* Hemsl.** (*Syn. Eupatorium Rebaudianum*,—a small herbaceous plant of the composite family, a native of Paraguay, is assuming importance in view of the presence in its leaves of 6·2–6·5 per cent. of stevioside, a glucoside of the formula $C_{38}H_{60}O_{18}$. Its sweetening power is 300 times that of saccharose. On hydrolysis by acid or the enzyme present in the juice of *Helix Pomatia*, it yields steviol, $C_{20}H_{30}O_3$, and glucose. Emollient properties have been attributed to the glucoside; in any case, it is not toxic even if taken in strong doses. Stevioside is commonly employed in South America for sweetening drinks and bitter infusions. It can be extracted from the leaves of the *S. Rebaudiana*, with a mixture of ethyl and methyl alcohols (85 : 15) at a temperature of 60° C.

The plant grows wild in the great grasslands and especially in marshy areas of Paraguay. In view of the possible industrial application of stevioside, particularly in food preservation, the plant is likely to assume great economic importance in the near future.

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The Use of Beryllium Chloride in Organic Chemical Reactions.—A summary of interesting work carried on by H. Bredereck, G. Lehmann, E. Fritzche and C. Schoenfeld at Leipzig and details of which will be published shortly in the *Berichte* is contained in the *Deutsche Bergwerks Zeitung* (No. 162, July 1939). It has been found that beryllium chloride can successfully replace anhydrous aluminium chloride in Friedel-Krafts reactions and in the synthesis of ketones, as also in condensation, polymerisation and "Cracking" reactions. In every case, however, a higher temperature than with aluminium chloride is found necessary. Typical yields were 6% diphenyl methane (benzyl chloride and benzene), 33% acetophenone (acetyl chloride and benzene), 27% mesityl oxide and 17% phorone (acetone), while the "Cracking" of anthracene and phenanthrene in the presence of beryllium chloride yielded up to 15% of liquid products. The "Cracking" of coal tar was not so successful.

EMMENNAR.

* * *

A New Wood Preservative.—An American Patent (Am. P. 2,149,284) by A. Gordon, Berkely, Cal., U.S.A., describes the composition of a new wood preservative. According to the details contained in the *Deutsche Bergwerks Zeitung* (No. 178, Aug. 1939), 63·2 kg. of copper sulphate crystals ($CuSO_4 . 5H_2O$) are

dissolved in 200 kg. of water; the copper is precipitated by the addition of caustic alkali obtained by dissolving 20·224 kg. of sodium hydroxide in 50 kg. of water. The precipitate is dissolved in an ammoniacal solution (17·75 kg. of ammonia in 1000 kg. of water) and to this solution of cupric ammonium hydroxide is added 21·2 kg. of "arsenic" (presumably the pentoxide) and 0·6 kg. of ferric acetate. The preservative thus obtained can be diluted with (up to) three parts of water. It is claimed that wood impregnated with a solution of this composition would retain the copper and arsenic in insoluble (and therefore unleachable) forms and thus remain immune to the action of wood-destroying organisms. EMMENNAR.

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Pigments in Living Human Skin.—Employing spectro-photometrical methods E. A. Edwards and S. Q. Duntley (*Amer. Journ. Anat.*, 65, No. 1, p. 1) have determined the pigments and colour of the human skin. Five pigments and one additional optical effect are responsible for the human skin colour. They are melanin, melanoid, carotene and reduced and oxyhæmoglobin. The melanin is found in the deeper layers of the epidermis; melanoid which has been discovered for the first time by the authors in the human skin is allied to melanin and is found throughout the epidermis. Carotene is found both in the epidermis and in the dermis. The hæmoglobin is found in the vessels of the dermis and subcutaneous tissue. All these pigments absorb rather heavily in the blue end of the spectrum and are therefore red to the eye and the only reason why human skin does not look red is because of the overlying turbid stratum corneum. The turbid epidermis, on account of a scattering of light raises the blue end of the spectrum over what it would otherwise be if the epidermis were transparent. The glands of the skin and their secretions have no effect on the colour of the skin. Females differ from males in possessing more carotene in their skin but less melanin and blood. The difference between the coloured and white races of humans rests only in the amount of melanin present. Pigments not found in white races are not encountered in coloured races and the general plan of distribution of the pigments is identical in the two races.

* * *

Spermatogenesis in *Schizocosa crassipes* (A lycosid spider).—A detailed account of the behaviour of the chromosomes in meiosis is given by W. L. Hard (*J. Morph.*, 65, No. 1, p. 121). The diploid number of chromosomes in *Schizocosa crassipes* is 22, of which 20 are autosomes and two are univalent accessory chromosomes. The spermatogonial divisions are two in number. During prophase of meiosis a presynaptic split is visible in the leptotene threads. A centromere also is visible. The distinct separation of the homologues all through prophase makes detailed examination of the chromosomes possible. The presynaptic split which is observed during synapsis reappears during diakinesis. The first division segregates the chromosomes. An interkinesis follows it and the second division is simple and equational.

* * *

Locusts in India and Their Control.—It is rather unfortunate that until recently the control of the locust pest in India did not receive that amount of attention by way of research which it deserves. Locusts are associated with destruction, and devastation on a colossal scale and have led in the past even to the depopulation and decay of whole countries. Like the allied visitations of famines and epidemics these outbreaks cease to receive any sustained study or other practical action once they are completely over or remain in comparative quiescence. It is therefore gratifying that its study on a systematic basis and as an important long range investigation should have been undertaken by the Imperial Council of Agricultural Research and that it should be receiving continuous attention. During the last few years that the studies have been in progress a mass of valuable data from both the scientific and practical points of view has been collected and it was a happy idea that a resume suitable for the use of practical farmers should be published (Y. Ramachandra Rao, *Agr. & Live-Stock in Ind.*, 9, Pt. III). What locusts are, how they are related to and can be distinguished from the other members of the grasshopper class to which they belong, the locust proper—the so-called desert locust—which causes the devastation connected with its name, the nature of the infestations, its cycles, seasons and areas of infestation, breeding grounds, the direction of flight of the migratory swarms, the solitary or quiet phase of the incidence, the relation of weather conditions to outbreaks and as a guide to the forecast of possible outbreaks, the various aspects of the control problem and its methods —are dealt with in all their essential features in a manner admirably suited to a popular account. The outstanding element of the problem is that of its being linked up closely with conditions not only in the desert tracts of India and its mountainous north-western frontier, but countries far afield outside of India. Thus the main centres of incipient outbreaks are located in the hinterland of British and Iranian Mekran, and a method of attacking the control problem at its very root will be to arrange for an organisation to keep a close watch in these areas and deal with the incipient swarms as they arise and thus prevent them from reaching their summer breeding areas in India. The winter rainfall areas of Baluchistan are said to be the danger points as regards locust infestation in north-west India and control work here will similarly attack the problem at its root as regards this part of India. In fact, the studies reveal the all-important need of an all-the-year-round work for a permanent organisation irrespective of whether there is an outbreak or not in India, more or less in the nature of an insurance against the pest outbreak.

The methods of combating the pest once it has appeared are reviewed, and many of these have been either suggested or tried at various times. The salient points in the life-history are described so as to indicate vulnerable features which can be suitably exploited, and control methods suited to the different stages in the life of the pest are discussed. Fighting

the adult swarms with the help of aeroplanes was found successful in Rhodesia but the author doubts if it can suit Indian conditions. In view, however, of the many-sided progress in flying craft in recent years we should think that it cannot be beyond the talent of inventors to adapt the method to this purpose. Dealing with egg-masses, the control of hoppers by means of trenches, poison baits of different kinds and so on are described, some of the latter being found very efficient.

There is a gloomy forecast of a definite danger of a new outbreak of the Desert Locust in the near future to which the author draws attention; let us hope, the results of these studies will be suitably made use of against such an outbreak on the principle of 'to be forewarned is to be forearmed'. A. K. Y.

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Ozone Concentration in Stratosphere.—According to a Communique issued by the National Geographic Society, Washington, D.C., three recent flights into the stratosphere over Beltsville, Maryland, by means of groups of rubber sounding balloons reached heights of 14 to 16½ miles above the earth. The balloons, sent up as a joint project by the **National Geographic Society** and the **National Bureau of Standards**, carried on each flight as an "observer" an ingenious robot consisting of electric batteries, a tiny motor, photo-electric cells, moving screens, and radio tubes.

The object of the flights was to gather additional information about the atmosphere's ozone layer—an important concentration of the gas which screens away from the earth's surface certain rays of sunlight injurious to vegetable and animal life. The metal and glass robot made "readings" of the varying concentrations of ozone at different altitudes and automatically radioed them to a receiving station on the ground. The results are being compared with other observations for a later report by the **National Bureau of Standards.**

On each of the three flights the lifting power was furnished by six rubber, hydrogen-filled balloons attached in tandem. Four-and-a-half feet in diameter when they were released, these balloons expanded to diameters of 14 feet or more in the rare upper air near the top of the ascents.

The string of balloons continued to rise until one of them burst as a result of expansion. The remaining balloons lowered the observing apparatus slowly to the ground and in every case it was recovered. The flights were made under the supervision of Dr. Lyman J. Briggs, Director of the **National Bureau of Standards**, and Dr. W. W. Coblentz, Chief of Radiometry, at the Bureau.

In the hope of reaching greater altitudes for the co-operative study of ozone concentrations, the **National Geographic Society** is now having large rubber balloons fabricated. In the mean time improved instruments for detecting ozone and for radioing information back to earth are under construction in the laboratories of the **National Bureau of Standards.**

* * *

Aurora Borealis.—The unusual display of the aurora borealis on the night of August 11, visible over the northern portion of the United States and Canada, was scientifically clocked, photographed and measured more completely than any other auroral display that has occurred in many years. Scientific observers pronounced it the most brilliant and extensive aurora of 1939 and one of the most striking in the past ten years, says a press communique from the **National Geographic Society.**

A three-year study of auroras is being made as a joint research project by the **National Geographic Society** and **Cornell University**, and has been in progress for nearly a year with observation stations set up at Ithaca, Hamilton and Geneva, N.Y. The stations are connected by direct telephone wires, and during the exceedingly brilliant display of August 11, made numerous photographs simultaneously. Comparison of these exposures made many miles apart will make it possible to estimate with considerable accuracy the heights above the earth of the various features of the display.

Dr. G. W. Gartlein of the Physics Department of Cornell University in charge of the co-operative studies, reported that at Ithaca the illumination from the aurora was almost like full moonlight and that automobiles were driven without headlights. He stated that the stations obtained more than 150 photographs, a score of them in natural colour, and 500 exposures with a motion picture camera. He also made a number of spectrograms and was successful in obtaining an automatic photo-electric record of brightness of the later portion of the display.

* * *

Indian Drugs for Treatment of Cattle.—The Imperial Council of Agricultural Research has sanctioned three schemes, at a cost of over a lakh of rupees, for research in Indian drugs to be used in the treatment of cattle. The schemes will cover investigations into the cultivation of medicinal plants, the efficacy of indigenous drugs and the indigenous treatment of cattle.

Lt.-Col. R. N. Chopra, of the School of Tropical Medicine, Calcutta, has been granted Rs. 62,860 for a five years' scheme. The researches under this scheme cover the survey of medicinal plants which can be grown in India, chemical analysis of their pharmacological and therapeutic action and an investigation of food poisons, particularly in cereals.

The second scheme which will be a study of poisonous plants and of their doses required in veterinary practice, will be controlled by the Surgeon-General of Madras. This will be a three years' scheme and will cost Rs. 39,000. The object of the scheme is to examine how far indigenous drugs can take the place of the imported ones.

The third scheme sponsored by the Premier of Orissa, is for the collection of literature about cattle treatment by indigenous drugs. It has been sanctioned initially for a period of six months at a cost of Rs. 4,500. Information from manuscripts and other sources is being collected and collated.

As two of these three schemes are veterinary, they will be correlated to the comprehensive survey of cattle diseases already being

made by the Imperial Veterinary Research Institute, Mukteswar, through the Veterinary Investigation Officers.

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Cardamom Beetle (*Thamnurgides cardomomi* Schauff), which is regarded as a serious pest of cardamoms in Coorg, Mysore and Madras, breeds actually in the fruits of several forest trees, and attacks cardamoms *only* when in unusual abundance. It does not breed in the dried, stored cardamoms but bores into green fallen cardamom fruits in malés located in broods. The pest is not responsible for the failure of the crop in Coorg as has been erroneously assumed.

Damage to the crop can be prevented by not growing cardamoms in the vicinity of these dangerous trees or by keeping the ground clean of their fallen fruits.

A recent survey made to discover the alternate food plants of the borer resulted in the discovery of 17 new species of *Thamnurgides* and 5 of *Coccotrypes* (*Ind. Forest Records*, 1939, 5, 279).

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***Calopepla leayana* Latr.**—A plantation of *Gmelina arborea* intended for pitwood was destroyed by an insect pest at Namtu in the Northern Shan States, Burma. The loss is estimated at Rs. 4,50,000. Mainly owing to the damage done by the beetle, a block of 1,600 acres was abandoned in 1934 and another of 1,400 acres in 1936.

The insect *Calopepla leayana* Latr. has been causing extensive damage to this tree in Assam, Bengal, Madras, the United Provinces, and Burma and is found from 500 feet above sea-level in the foothills rising out of the Irrawady plains to about 8,000 feet above sea-level at Darjeeling.

Not only leaves but buds and young growing shoots are chewed, and two consecutive years of the attack kill the trees.

Methods of control used by the Forest Entomologist in Burma are discussed in an issue of the *Indian Forest Records* (New Series) entitled "Biology of *Calopepla leayana* Latr. and the Possibilities of Control", just published from the Forest Research Institute and College, Dehra Dun.

The natural enemies of the beetle include a predaceous bug (*Canthecona furcellata*), a Chalcid egg parasite (*Tetracampe* sp.) and a pupal parasite (*Brachymeria* sp.).

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Variations in Rainfall.—A new method of analysis based on the π test suggested by Dr. S. R. Savur in which the median is used in place of the arithmetic mean, has been adopted by Mr. L. S. Mahalingam in studying the variation of rainfall in India (*India Meteorological Department Scientific Notes*, No. 82). The main conclusions obtained from the analysis are:—The rainfall associated with thunderstorms in the hot weather months, March to May, is differentiated from the rainfall of the monsoon months in almost all stations. During the monsoon months rainfall in July is greater than in June except in Burma and parts of northeast India. Rainfall in July is not significantly different from that in August except in the western parts of the Peninsula. September shows generally a distinct decrease from August, except in the southern and eastern parts of the Peninsula.

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Large-scale City Surveys.—The value of large-scale city surveys for settlement and town planning purposes is being increasingly recognised in India. A survey of Lahore is now in progress and numerous experimental measures have been adopted for the survey and should they prove successful there is little doubt that other municipalities will follow the lead of Lahore. A large-scale survey has already been commenced at Murree. According to a press note issued from Simla, the Lahore survey is being made on the scale of 40 feet to one inch in the congested areas and 100 feet to one inch in the open areas. The work is being carried out under the control of the Director, Frontier Circle, Survey of India.

"The work presents many problems from the technical point of view, not the least of which are the transference of accurate positions from the tops of houses, where the triangulation had to be carried out, to the ground; and the control of traffic so as to prevent disturbance to delicate instruments or obstruction to view, during the course of observations.

"To expedite the fixing of details which forms the major part of the work and to ensure its accuracy, a new type of 'offsetting instrument' and new plotting scales have been devised several of which have been manufactured by the Mathematical Instrument Office of the Survey of India and put into use with satisfactory results.

"The use of these special instruments and the experience gained in Lahore, it is hoped, will bring the cost of these highly accurate surveys which had hitherto been regarded more or less as a luxury within the means of the major cities and towns of India."

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The King Crab.—At the ordinary monthly meeting of the Royal Asiatic Society of Bengal held on Monday, the 4th September, Dr. H. S. Rao of the Zoological Survey of India exhibited a king crab. "The king crab is a curious marine creature which has lived through millions of years up to the present time practically unchanged in its general morphological features. Its closest allies are probably among the scorpions and prawn-like crustaceans, but may not be classed with the groups to which these belong. It has a wide distribution along the Indo-Malayan, Chinese and Japanese coasts and along the East coast of North and Central America. There are two species of King Crabs which inhabit the East coast of India. One is essentially marine and lives on a sandy or muddy bottom up to a depth of twenty fathoms while the other is mainly estuarine ascending the River Hughli as far as Calcutta. In the breeding period of the marine species which corresponds to the close of the cold weather in Bengal and Orissa, king crab may be seen in pairs, the male—which is smaller in size than the female—has the second and third pairs of limbs of the front part of the body modified

as a clasper holding firmly on to the shield-like back of the female."

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The Annual Report of the **Health Organisation of the League of Nations** has been included in the latest issue of the *Bulletin of the Health Organisation* of the League (Vol. 8, Nos. 1–2).

Prevention and treatment of malaria, cancer, leprosy, bilharziasis and rabies; medico-social action in the sphere of rural hygiene, nutrition, housing and physical education; epidemiology and health statistics; biological standardisation; campaign against narcotic drugs; unification of pharmacopœiæ and anti-epidemic action in China—these are the sub-heads of the report. The wide field comprehended by the League of Nations in its work of international co-operation and in its efforts to raise the standard of health, will become manifest by a perusal of this report.

The *Bulletin* also includes (1) an article entitled "Health Indices", which is a skeleton standard report for use in surveys of the state of health and vitality of a given population, (2) the report by M. Vignerot (France) on "Rural Housing and Planning", and lastly, (3) an article on "Leptospiroses" by Dr. Walch-Sorgdrager.

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The Government of Mysore have notified that with effect from October 1, 1939, in the Bangalore and Tumkur Districts, including the City of Bangalore, no petrol shall until further orders be sold or kept for sale except with an admixture of alcohol manufactured in the Distillery established by the Mysore Sugar Company, Ltd., at Mandya. The proportion of petrol and alcohol in the mixture shall be 85:15 by volume.

Mysore has been the first to pass such a legislation. Several Provincial Governments in British India are adopting legislation of this nature.

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The inauguration of the St. Xavier's College (Bombay) **Natural Science Association** took place on the 25th of last month when Lt.-Col. Bhatia addressed the assembly. The Association was founded during the year by a band of enthusiastic students who have secured the support of the Principal. The Association aims to subscribe for as many specialised scientific periodicals as possible, to arrange for lectures and discussions, and to promote the development of Natural Sciences.

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We have pleasure in announcing that **Dr. W. L. Davies**, Director of Dairy Research, Simla, has accepted our invitation to join the Board of Editorial Co-operation.

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University of Mysore.—(1) *Admissions during* 1939–40: The student strength of the University during 1939–40 including the Medical School and the School of Engineering, Bangalore, was 3,601 as against 2,891 during 1938–39.

(2) *Physical Education and Military Training*: Physical Education has been made compulsory in the men's colleges in the University with effect from the Junior Intermediate class of the current year. Facilities for the Military Training of a hundred students in each centre have been provided from this year.

(3) *Women's College*: The degree classes of the Maharani's College for Women in Mysore were transferred to Bangalore and a Science section was introduced in the Maharani's Intermediate College at Mysore.

(4) *Examinations*: The results of the M.A., M.Sc., and Final M.B.B.S. examinations were published. They were as follows:—

Name of Examination	*No. Examined*	*Passed*	
		I Class	*II Class*
M.A.	11	7	3
M.Sc.	12	4	7
M.B.B.S. (Part I) ..	7	..	6
,, (Part II) ..	12	..	7

(5) *Convocation*: The 22nd Annual Convocation of this University will be held at Mysore on Wednesday, the 25th October 1939. Sir Nripendranath Sircar, retired Law Member, Government of India, has kindly consented to deliver the Convocation Address.

(6) *Fellowship*: A scheme of fellowships tenable for three years each has been sanctioned in place of the scheme of post-graduate research scholarships tenable for a year each.

(7) *Deputations*: Messrs. C. K. Sundarachar and L. Narayana Rao have been deputed for advanced studies in Physics and Botany respectively and Mr. P. H. Nagappa for Actuarial Science.

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University of Bombay.—The degree of Ph.D. in Botany has been conferred on **Mr. T. S. Mahabale, B.A., M.Sc.**, of the Gujarat College, Ahmedabad, in consideration of his thesis on the genus *Ophioglossum* in India. Mr. Mahabale's work is comprehensive and has been highly spoken of by the examiners. He is the first Ph.D. in Botany of the Bombay University.

Industrial Notes

Vitreosil.—*Messrs. The Thermal Syndicate, Ltd.*, London, have sent us an illustrated brochure, which contains valuable information regarding Vitreosil or pure fused quartz and silica, which possesses "remarkable properties of great value for scientific and technical purposes". It is well known that in many laboratory operations, especially those where heat or acids are involved, Vitreosil has almost replaced, not only platinum and other costly materials but also porcelain.

The Thermal Syndicate which pioneered the production of comparatively small pieces of laboratory ware from fused quartz are now in a position to fabricate large chemical and other plants as regular items of manufacture. They have extended their activities to the production

of cooking ware, the requirements of the electrical and gas industries and the medical profession. They have not ignored the possibility of utilising the artistic and decorative efforts presented by the remarkable rippled silver-like appearance assumed by certain forms of fused silica.

Both translucent and transparent varieties of Vitreosil are manufactured; the transparent kind has proved invaluable in connection with radio therapeutic mono-chromatic and ultra-violet light apparatus. Highest qualities of their transparent material are available for lenses, prisms and other optical purposes.

The brochure contains a detailed account and data of the mechanical, chemical, thermal, optical and electrical properties of vitreosil, gives a few of the numerous applications of the various sizes and shapes manufactured by the Syndicate and includes an extensive bibliography of 205 references to scientific literature.

Centrifugals.—Centrifugal separations constitute one of the fundamental unit processes in chemical engineering practice. Different types of centrifugals, to meet varying requirements of industry are now on the market, among which the Broadbent centrifugals enjoy a world-reputation for efficiency and relativity. These centrifugals are backed up by seventy years' experience which *Messrs. Thomas Broadbent & Sons* have acquired in the fabrication of these machines. Every possible improvement incorporating all the very latest developments in engineering and metallurgical practice is embodied in their design and manufacture. The seventy-six page illustrated pamphlet issued by this enterprising firm, gives an idea of the wide variety of centrifugals and hydroextractors fabricated by them. Those interested in these machines should get into touch with Messrs. Thomas Broadbent & Sons, Ltd., Huddersfield, England, who will be pleased to furnish further information and data.

According to a notification issued by the Research Department of the **Instiute of Automobile Engineers**, two new items of research have recently been added to the programme of work being carried out by the Automobile Research Committee. One of these items relates to the effect of radio interference suppressors on engine performance: in this connection, there is a possibility that the fitting of interference suppressors in the spark-plug high tension leads may have to be enforced on all cars in order to avoid interference with short-wave wireless reception, particularly television. It is therefore important to ascertain whether these suppressors have any adverse effects on engine performance, and experiments are now being carried out at the Brentford Laboratories on single- and multi-cylinder engines, a cathode ray indicator being used to study the effect of suppressors on ignition and combustion.

The other new item of research relates to the over-heating of brake drums and wheel rims on commercial vehicles. Under modern conditions, the transfer of heat from brake drums to the wheel rims is sometimes excessive, resulting in a serious shortening of tyre life. A back axle, complete with wheels and brake drums, is being used for a laboratory study of heat dissipation from the brake drums, and various methods of insulation and ventilation are being tried.

Mysore Timbers.—The Forest Research Section of the Forest Department of the Government of Mysore, has issued a series of well got up pamphlets describing the habitat of the commercially important lumber stands of Mysore. The characteristics of the sap and the heart woods such as texture, strength, susceptibility to decay, durability in contact with water, workability, decorative value and adaptability to certain special purposes, are indicated. We have no doubt that when the Forest Research Section is fully equipped with testing machines, we shall have quantitative data regarding the above characteristics. A small piece of panel of the timber in question attached to each of the pamphlets, adds vividly to the descriptive contents of the leaflet. These pamphlets will be of immense value not only in bringing to light the timber resources of the State, but also in advancing the technology of timber in general.

Announcement:

Indian Science Congress, 1940.—At the next session of the Congress to be held in Madras in the first week of January 1940, it is proposed to have the following 4 Discussions in the **Geology** Section:

1. The Ice Age (Pleistocene) in India (jointly with the Sections of Physics, Botany, Zoology, Entomology and Anthropology).
2. Types of Topography based on the erosion of rocks (jointly with the Section of Geography and Geodesy).
3. Possible Mineral Industries of South India (Section of Geology).
4. Classification and age limits of the Gondwana System (Section of Geology).

Members who wish to participate in one or more of these Discussions will please write, as early as possible, to Prof. L. Rama Rao, Department of Geology, Central College, Bangalore, enclosing, if possible, a summary of their contribution.

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We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, No. 12, and Vol. 59, No. 1.

"Agricultural Gazette of New South Wales," Vol. 50, No. 8.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 4.

"The Philippine Agriculturist," Vol. 28, No. 3.

"Monthly Bulletin of Agricultural Science & Practice," Vol. 30, Nos 6–7.

"Allahabad Farmer," Vol. 13, No. 4.

"Biochemical Journal," Vol. 33, No. 7.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 72, No. 8.

"Journal of the Institute of Brewing," Vol. 45, No. 8.

"Biological Reviews," Vol. 14, No. 3.

"Journal of the Indian Chemical Society," Vol. 16, No. 6.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

August 1939. SECTION A.—N. V. SUBBA RAO, J. VEERABHADRA RAO AND T. R. SESHADRI: *A note on the preparation and reactions of karanjin.*—Karanjin is only faintly bitter. A method of hydrolysis of karanjin giving rise to a good yield of karanjic acid has been found. P. A. MOSES: *Raman spectra of fused nitrates.*—Sodium, potassium and aluminium nitrates have been studied, and the polarisation characters of the Raman lines also determined. The intensity and polarisation in the wing accompanying the Rayleigh line λ 4046 of fused sodium nitrates show some characters as in common liquids. S. PARAMASIVAN: *The Pallava paintings at Conjeevaram.—An investigation into the methods.* S. PARAMASIVAN: *The wall paintings in the Bagh caves.—An investigation into their methods.* P. BHASKARA RAMA MURTI AND T. R. SESHADRI: *Chemical composition of Indian Senna leaves* (Cassia angustifolia).—The flavonol portion consists of iso-rhamnetin and kaempferol in more or less equal quantities, whereas the anthraquinone portion contains mostly rhein along with small quantities of emodin.

August 1939. SECTION B.—MAKUND BEHARI LAL: *Studies in Helminthology.—Trematode parasites of birds.* K. M. THOMAS AND C. S. KRISHNASWAMI: *Little leaf.—A transmissible disease of Brinjal.* B. R. SESHACHAR: *Testicular ova in* Uraeotyphlus narayani *Seshachar.* I. FROILANO DE MELLO: *Two new additions to the list of the Indian Aspergilli.*

Indian Chemical Society:

June 1939.—S. S. BHATNAGAR, A. N. KAPUR AND MAHENDRA SARUP BHATNAGAR: *Adsorptive properties of synthetic resins—Part III.* R. K. BAHL AND SPUJIT SINGH: *A study of the periodates of copper.* A. MUKHERJI: *The estimation of aneurin by the thiochrome reaction with pulfrich photometer.* (Late) N. W. HIRWE, G. V. JADHAV AND D. R. SUKHTANKAR: *Interaction of sulphuryl chloride with arylamides of aromatic acids—Part II. Orienting influences of groups in substitution reactions in aromatic compounds.* N. M. SHAH: *Chloralides, the condensation of Butylchloral with α-Hydroxy carboxylic acids.* MUHAMAD QUDRATI-I-KHUDA AND SUBASH KUMAR GHOSH: *Chemistry of substituted Ring compounds—Part I.—Synthesis of* aaγ*-Trimethyl* cyclopentanone. JAGRAJ BEHARI LAL: *Studies in Chalkones—Part I. Chalkones derived from Resacetophenone and its dimethyl ether.* U. P. BASU AND P. K. DAS-GUPTA: *On 2-phenyl-4-aminoquinoline derivatives.* M. K. SRINIVASAN: *Viscosity of non-ideal binary liquid systems.* EDWARD BARNES: *A note on the action of strong solutions of alkalis on potassium ferricyanide.*

August 8, 1939.—DR. H. K. SEN: *Shellac in Moulding and Varnish Industry.*

Mining, Geological and Metallurgical Institute of India: *Transcations*

June 1939.—B. SEN AND M. V. WAZALWAR have expressed their views on Dr. Crookshank's paper on *"The iron ores of the Bailadila Range in Bastar State"*, with special reference to the possibility of exporting these ores to the Far East, Japan and China.

E. B. PARK has a paper of great importance on *Methods of detection and dealing with Heatings and Fires in coal mines"*,—which is eminently practical in its character. The discussion on this paper will no doubt be read with great interest by those who are concerned with the coal mining industry in India.

The methods of obtaining sand for hydraulic stowing in India, have been described by Messrs. L. J. BARRACLOUGH AND S. B. HALL, and this paper will be welcomed as a valuable contribution, full of practical details, on a subject of great current interest.

A short paper on *Quantity measurements in hydraulic mining by the Monitor* by MR. K. B. SWAMY, deals with the value of and method of carrying out, recurrent surveys for assessing the results of hydraulic mining of hill faces by Monitors, and with the duty of water in hydraulicking.

National Academy of Sciences, India:

August 4, 1939.—H. R. MEHRA: *New Bood Flukes of the family* Spirorchidae *Stunkard (Trematoda) from the Marine Turtle Chelonemydas of the Arabian Sea with the observations on the synonymity of certain Genera and classification of the family.* SHRI RANJAN AND V. R. JHA: *Studies on the effect of Ethylene and Sulphur dioxide on the fruits of* mangifera indica. SHRI RANJAN AND G. N. SAPRU: *Studies on the effects of Ethylene on the ripening process of Guava* (Psidium guava). N. S. JAPOLSKY, Davy Faraday Laboratory, Royal Institution, 21, Albemarls Street, London, W. 1. (Communicated by The Hon'ble Sir Shah Muhammad Sulaiman, KT.): *The Radion and the Electro-Magnetic whirl.* MAHADEO PRASAD GUPTA, JAGRAJ BEHARI LAL AND SIKHIBHUSHAN DUTT: *Constitution of Cuscitalin.* JAGRAJ BEHARI LAL: *Theory of Zinck's Reaction.* BRAJ KISHORE MALAVIYA AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil from the peels of Nagpur oranges.* BRAJ KISHORE MALAVIYA AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil* Curcuma caesia. JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil of* Hedychium spicatum. JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the seeds of Euphorbia dracumculoides: composition of the fixed oil.*